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Voluntary Male Circumcision and Risk for Human Immunodeficiency Virus in Homa Bay, Kenya

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College of Health Sciences

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George O. Gabriel

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Walden University
2020

Abstract

Voluntary Male Circumcision and Risk for Human Immunodeficiency Virus in Homa Bay, Kenya

by

George O. Gabriel

MPH, International Health Sciences University, Uganda, 2011

BBM, Moi University, Kenya, 1998

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health, Specialization in Epidemiology

Walden University

November 2020

Abstract

The role played by the belief about voluntary medical male circumcision (VMMC) in predicting HIV status has not been examined. The purpose of this study was to investigate whether there were any differences between belief about VMMC, unprotected sex, age, number of sexual partners, relationship status, and HIV status among circumcised males aged between 18-49 years in Homa Bay County, Kenya. Drawing from the health belief model and case-control study design, 936 men were recruited based on their HIV status (468 HIV cases and 468 controls). A bivariate logistic regression was applied, and the results indicated that unprotected sex, age, number of sexual partners, and relationship status were associated with HIV status, while belief about VMMC in isolation and after controlling for other variables was not. Those who had unprotected sex were 62% more likely of being HIV positive than those who had protected sex (*OR* = 0.622, 95% CI [0.320, 0.924], p<.001); the odds of being HIV positive among males aged 39-49 years was 1.754 times higher than those 18-24 years (*OR* = 1.754, 95% CI [1.336, 2.171], *p* < .001); one increase in number of sexual partner increased the likelihood of being HIV positive by 13% (*OR* = 0.454, 95% CI [0.366, 0.542], *p* = .005); and multiple relations increased the probability of being HIV positive by 1.535 times (*OR* = 1.535, 95% CI [1.203, 1.868], *p* = < .001). HIV prevention strategies should target males aged between 39-49 years who engage in unprotected sex with a greater number of partners. This study adds to positive social change by providing policymakers and health stakeholders with baseline data on sexual behaviors to impact HIV prevention.

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Dedication

I dedicate this work to my late father's memory, my guardian angel, Gabriel (*Omugerezi*). He taught me the value of being focused on pursuing my passions and future goals. Having been a successful career as a teacher, despite coming from a background of poverty, taught me how to take everything seriously and push to the limits of greatness. With appreciation, I will always remember you in my heart as I believe you are still watching over me.

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I am much indebted to the support of my wife, Dr. Mildred Mwigali, for a continuous source of love, strength, encouragement, and inspiration that always made my mind relax when the dissertation journey appeared insurmountable. I appreciate her desire for me to complete this journey quickly and promptly, taking over all the parental duties when I was too busy to satisfy them. Finally, special thanks to my mother, Agnes (*Omukazi Omugerezi*), for her constant prayers, countless sacrifices for my siblings and me.

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Chapter 1: Introduction to the Study

Introduction

The conclusions of the three randomized controlled trials (RCTs) conducted in Uganda, Kenya, and South Africa established that voluntary medical male circumcision (VMMC) decreases female-to-male sexual infection of human immunodeficiency virus (HIV) by approximately 60% (Kamath & Limaye, 2015). This finding has remained universally welcomed, being the most significant advancement in HIV prevention. However, it might also have led to an upsurge in risky sexual behaviors among circumcised males (Chikutsa, Ncube, & Mutsau, 2015).

The majority of communities in Nyanza province in Kenya are traditionally not practicing male circumcision (L'Engle, Lanham, Loolpapit, & Oguma, 2014; National AIDS Control Council [NACC] & National AIDS and STI Control Programme [NASCOP], 2014). Nyanza has the least male circumcision prevalence (religious, traditional, and medical; 46.4%) and the highest HIV prevalence (14.9%) in Kenya (NACC, 2016). Homa Bay County in Nyanza province has the highest new HIV infections (15,003 in 2015) and the highest HIV prevalence at 26% (almost 4.5 times higher than the national rate) in Kenya (NACC, 2016). However, between 2008 and 2013, about 792,931 VMMC procedures (males aged 15-49 years) were performed in Kenya, of which 28% (223,435 procedures) were from Homa Bay County, Kenya (Galbraith et al., 2014; NASCOP [Kenya], 2015; NACC, 2014). This meant the region had the highest number of recently performed medical circumcision cases (in the past 5 years). However, the rise in new HIV infections is being reported with the increased rate of VMMCs, hence the need to study if there is any association. As part of the HIV prevention plan, VMMC was introduced in Nyanza Province in 2008 (L'Engle et al., 2014). Homa Bay County has one of the lowest condom use rates in Kenya. Kenya Demographic and Health Survey reported that nearly 48% of males and 40% of females in Homa Bay County, Kenya, who reported multiple sexual partners had not used a condom during their most recent sexual experience (Kenya National Bureau of Statistics [KNBS] & ICF Macro, 2014).

Studies done in Kenya, Zimbabwe, Zambia, Uganda, and Malawi on VMMC and behavioral disinhibition (vulnerability to unprotected sex) amongst the circumcised males has dismissed the fear that VMMC was motivating risky sexual behaviors (Chikutsa et al., 2015; Westercamp, Agot, Jaoko, & Bailey, 2014). However, other studies done in Uganda and Orange Farm, South Africa, reported that circumcised males participated more in risky sexual behaviors compared to uncircumcised males (Gray et al., 2012; Kibira, Nansubuga, Tumwesigye, Atuyambe, & Makumbi, 2014; Kibira, Sandøy, Daniel, Atuyambe, & Makumbi, 2016; Phili, 2014). Behavioral disinhibition (vulnerability to unprotected sex) is a significant potential means that could adversely impact VMMC interventions (Westercamp et al., 2014). This called for further studies to measure if there is any association between unprotected sex and HIV status (Rositch et al., 2014).

In examining the links between the exposure and the outcome, the researcher will employ the health belief model (HBM). The model presupposes that the greater the apparent vulnerability and lower the perceived self-efficacy, benefit, seriousness, and cues to action and the higher the behavioral barriers by the primary target recipient, the lower the probability the person might take a specific health behavior/action to prevent the disease (Glanz et al., 2008; Rosenstock, 2005). The study could positively impact social change by contributing empirical knowledge for future public health interventions and HIV prevention programs. Besides, it could help organizations implementing VMMC initiatives for HIV prevention in Homa Bay County, Kenya, in designing, implementing, and monitoring their programs, which could contribute to a positive social change. HIV being a disease with public health importance in the lives of people of Homa Bay County, Kenya, the findings of the level of risk of unprotected sex on HIV seroconversion could help design future interventions that could create a positive social change. In this study, I examined whether there are any differences between HIV positive and HIV negative circumcised males regarding their beliefs associated with the false protection of circumcision and related unprotected sexual activities in Homa Bay County, Kenya.

In this chapter, I provide a concise synopsis of the study background, problem statement, study purpose, and research questions and hypotheses. I also highlight the framework, nature of the study, definitions of terminologies used, assumptions and limitations, scope and delimitations, and study significance. The section concludes with a concise synopsis of the chapter and changeover to Chapter 2.

Background

In the Kenya trial, comparing circumcised men with matched controls (uncircumcised), the cases showed slightly riskier sexual behaviors on all of the five examined measures (including condom use, number of sexual relationships, use of alcohol in the course of sexual intercourse, transactional sex, and extramarital sex) at month 24 (Westercamp et al., 2014). Westercamp et al. (2014) further reported that measures on unprotected sex with all types of sexual relationships in the preceding 6 months and reliability of condom use amongst the circumcised were found to be statistically significant. They argued that the variances among the cases and control groups were attributed to the rise in safer sexual habits in the uncircumcised group instead of increased risky sexual behavior among the circumcised. Any other author has not verified this claim.

Kibira et al. (2016) analyzed the data from 2004 and 2011 behavioral surveys in Uganda and reported a rise in risky sexual behaviors among circumcised males due to their perceived low HIV risk. They also reported a strong association between male circumcision with non-cohabiting partners and multiple sexual partners. The authors deduced that there were lower condom use and a higher prevalence of behavioral disinhibition among circumcised males. This article contained the latest findings from a bordering country (Uganda) and reinforced one of the research questions for this study. Kibria et al. (2016) also supported the suggestion for using non-experimental methods of assessing behavioral change. The authors reported a negative association of condom use among circumcised males with the last non-spousal partner.

Westercamp et al. (2014) and Gray et al. (2012) reported no proof of behavioral disinhibition among males following circumcision. Westercamp et al. indicated the association of increased condom use with VMMC. However, these findings are conflicting with other results of the studies done in Swaziland, Kenya, and Orange Farm, South Africa, that presented a higher average of risky sexual behaviors amongst men in the initial 24 months after circumcision (Auvert et al., 2013). This inconsistency could be attributed to the selection bias as indicated by Westercamp et al. These studies are coherent with all studies done beyond the experimental setting (Rennie et al., 2015), which established some behavioral disinhibition amongst circumcised men.

VMMC was introduced as a supplementary constituent of the comprehensive HIV prevention package and was never meant to substitute other HIV prevention methods (World Health Organization [WHO] & Joint United Nations Programme on HIV/AIDS [UNAIDS], 2007). Phili (2014) highlighted the anxiety of health care workers that VMMC could be promoting behavioral disinhibition among the circumcised males as they were hesitant to use condoms with sexual partners. Phili concluded that there was a need for accurate awareness among health care workers and practical guidelines to illuminate the present misconceptions. Chikutsa et al. (2015) and Phili (2014) argued that most VMMC interventions provide insufficient circumcision counseling. Therefore, most men leave the VMMC counseling with the only information that 'VMMC provides protection.' The belief about VMMC as protective among circumcised men and their partners could be deemed risky for HIV infection (Grund & Hennink, 2012). Their perceived increased protection from HIV risk could raise their chances of engaging in unprotected sex (Rennie et al., 2015).

Various authors have provided stern warnings on the need for nurturing and instilling safe sexual practices when a new biomedical measure such as VMMC is introduced (Auvert et al., 2013; Eaton et al., 2012; Lawal & Olapade-Olaopa, 2017). The possibility of behavioral disinhibition may offset the partial protection of the new biomedical intervention strategy (Eaton et al., 2012). Abbott, Haberland, Mulenga, & Hewett (2013) stated that recently circumcised men in Zambia reported higher sexual risk behavior and were using their circumcision status to influence transactional/commercial sexual partners to have unprotected sex. Chikutsa & Maharaj (2015) and Abbott et al. (2013) indicated the need to make more information available on the actual amount of protection to counter the misapprehension about the benefits of VMMC. There is also a need to have a robust monitoring and evaluation system to continuously assess the protection benefits of the intervention and understand how the circumcised males contemplate their risk in the persence of a new biomedical measure (Pitpitan et al., 2015).

Behavioral disinhibition may occur in prevention and risk reduction interventions due to complacency from a misapprehension of the actual protection from the intervention. This perceived protection might expose the male to sexual risk (Rennie et al., 2015). Chikutsa et al. (2015) and Grund & Hennink (2012) reported behavioral disinhibition following circumcision and explained why some men want circumcision and precisely when risky behaviors occur. Nevertheless, the studies by Grund & Hennink (2012) and Gray et al. (2012) indicated inconsistent condom use among circumcised males in the initial 6 months following circumcision. This finding is consistent with other studies done in Kenya and South Africa (Grund & Hennink, 2012) that depicted a higher average number of sexual partners shortly after circumcision (in the first 180 days) and low condom use at 2 years. Zungu et al. (2016) argued that the benefit gained from the new measure could be endangered if not erased with a change in social and risk behavior.

Westercamp et al. (2014), while citing Agot (2007), highlighted the study done in Siaya and Bondo (in Nyanza) that indicated some behavioral shifts in risky sexual behaviors (moving from high to low and back to high). Although the authors deduced that there was no proof of behavioral disinhibition, there still remained some gaps in information and unanswered questions about the significant shifts in behavior in less than 15 months. Further research is warranted to assess behavioral variation among circumcised males (Hughes et al., 2012). This shift in behavior could result from social conditioning (beliefs about VMMC), cultural values, and moral issues (Hughes et al., 2012, p. 364).

There are limited studies (Abbott et al., 2013; Westercamp et al., 2014) outside the three RCTs that have tested the links between VMMC and risky sexual behaviors, which cannot be generalized to the general natural settings (Pitpitan et al., 2015). There is also insufficient literature available that measures the interaction between knowledge about the risk of unprotected sex and past beliefs about VMMC (Wilson, Xiong, & Mattson, 2014).. While citing Mattson et al. (2008), Grund & Hennink (2012) argued that it is challenging to present consistent evidence of behavioral disinhibition from efficacy trials. The WHO (2011) suggested that there is a need to examine behavioral disinhibition outside the experimental setting, where there is reduced or no intensive counseling. However, no study analyzing the association between belief about VMMC, unprotected sex, and HIV serostatus in Homa Bay County, Kenya, could be located in the available literature. This study proposes to address this gap.

Problem Statement

The public health campaigns promoting VMMC have skewed men's risk perception leading them to regard VMMC as providing complete protection against HIV rather than as partial protection (Chikutsa et al., 2015). There has been an upsurge of HIV incidence being reported with the increase in the rate of VMMC performed in the county, hence the need to study if there is any association. Previous studies have focused more on the effectiveness of VMMC as an HIV preventive measure (Ramaprasad Lang, & Sessa, 2014). Few studies have concentrated on the links between the belief about VMMC and unprotected sex and what benefits males attach to circumcision (Chikutsa & Maharaj, 2015; Grund & Hennink, 2012). Condom use among males reporting multiple partners in Homa Bay is about 40%, one of the lowest in Kenya compared to the mean for counties in Nyanza (47.6%) and national mean (42.8%; KNBS & ICF Macro, 2014). Previous studies conducted so far have provided inconsistent evidence of whether there is an association between VMMC and behavioral disinhibition. No significant research has been undertaken in Homa Bay County, Kenya, to investigate if there is a difference between HIV positive and HIV negative circumcised males regarding their beliefs associated with the false protection of circumcision and related to unprotected sexual activities. Secondly, the bulk of the studies done in Kenya and elsewhere were RCTs, which have been criticized for lack of real-life conditions in the natural community settings in addition to participant response bias (Rennie et al., 2015) and selection bias (Westercamp et al., 2014). According to Rennie et al. (2015), in RCT, the participants are regularly monitored, are provided with condoms, and receive intensive regular health education, care, and counseling (Kibira et al., 2016), which have enhanced the efficacy of VMMC during RCT, a situation that might not be simulated in natural setups (L'Engle et al., 2014). Close monitoring could also lead to the Hawthorne effect, resulting in a change of sexual behavior, making the circumcised group more aware of safer sexual practices and, therefore, more likely to implement them. Likewise, in RCT, the experiment sample does not represent a specific general population. Most RCTs done in Kenya included restricted age range (between 18-24 years), healthy males (not HIV positive or having STDs), sexually active, and enrolled in the RCT (those who are willing to undergo VMMC). Finally, those who are willing to participate in the RCT might be more likely to believe the efficacy of VMMC (Rennie et al., 2015; Z. Wang, Feng, Lau, & Kim, 2016). They might also already be engaging in unprotected sex (Chikutsa et al., 2015). This calls for further studies to examine if unprotected sex based on the beliefs associated with the false protection of circumcision is a risk factor to HIV infection in Homa Bay County, Kenya.

Purpose of the Study

The purpose of this study was to investigate whether there are any differences between belief about VMMC, unprotected sex, age, number of sexual partners, relationship status, and HIV status among HIV negative (controls) and HIV positive (cases) circumcised males aged 18-49 years in Homa Bay County, Kenya. Using a case-control (HIV positive cases after VMMC and HIV negative controls after VMMC) with exposure variables, the study assessed other risk factors of HIV infection. The dependent variable was HIV status (positive –no/yes). The independent variables were belief about

VMMC (perception about partial and complete protection), unprotected sex, age, number of sexual partners, and relationship status. VMMC status was defined as the medical cutting off of the foreskin. Most studies conducted to date on behavioral disinhibition are efficacy trials (Underhill, 2013). For this study, I used the quantitative approach with a case-control method to determine whether the imperil dynamics for HIV infection are different among HIV positive and HIV negative circumcised males in Homa Bay County, Kenya**.**

Research questions regarding the association between belief about VMMC and HIV status, controlling for unprotected sex, age, number of sexual partners, and relationship status.

Research Questions and Hypotheses

In the study, I tested the following research questions and null and alternative hypotheses, respectively.

RQ1: What is the association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

$H_0$1: There is no association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

H_a1: There is an association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ2: What is the association between engaging in unprotected sex and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

*H_0*2: There is no association between engaging in unprotected sex and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

*H_a*2: There is an association between engaging in unprotected sex and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ3: What is the association between age and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

*H_0*3: There is no association between age and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

*H_a*3: There is an association between age and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ4: What is the association between number of sexual partners and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

*H_0*4: There is no association between number of sexual partners and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

*H_a*4: There is an association between number of sexual partners and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ5: What is the association between relationship status and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

$H_0$5: There is no association between relationship status and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

H_a5: There is an association between relationship status and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ6: What is the association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya, controlling for engaging in unprotected sex, age, number of sexual partners, and relationship status?

$H_0$6: There is no association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya, controlling for unprotected sex, age, number of sexual partners, and relationship status.

H_a6: There is an association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya, controlling for unprotected sex, age, number of sexual partners, and relationship status.

A more comprehensive discussion of the study objectives, research questions, and hypotheses and how they were measured appears in chapter 3.

Theoretical and Conceptual Framework for the Study

Theoretical Foundation

I applied the health belief model (HBM as a theoretical foundation. I chose the HBM because the behavior of those who are circumcised is contingent on the subjective value of an outcome (HIV protection) (Ramaprasad et al., 2014)). HBM, in addition to subjective expectation, beliefs that a particular behavior or action (e.g., wanting VMMC or using a condom) will result in that outcome (e.g., protection from HIV; Glanz et al., 2008). The HBM has six key concepts: “perceived vulnerability, severity, benefits and barriers to a behavior, cues to action, and self-efficacy” (Tarkang & Zotor, 2015). The HBM predicts why individuals will choose an action (e.g., to have protected sex or want VMMC) to prevent or control disease (e.g., decide on HIV screening).

The HBM presupposes that the lower the perceived susceptibility, seriousness, benefit, promptness to action, and self-efficacy and the higher the perceived behavioral barriers, the lower the probability that the person will opt to take a specific health action to prevent the disease (Carpenter, 2010b; Glanz & Bishop, 2010). The HBM has been extensively employed as the main theoretical framework in most health sciences research. Ramaprasad et al. (2014) argued that about 64% of behavioral health research and health campaign initiatives found in the Medline database searched between 1974 and 1994 used the HBM as a conceptual framework. The HBM has been effectively employed in many replicated studies (Glanz et al., 2008) and in measuring risky health behaviors (such as unprotected sex) (Zhao et al., 2012), and consequently was favored in this study. A more thorough analysis will be found in Chapter 2.

Conceptual Framework

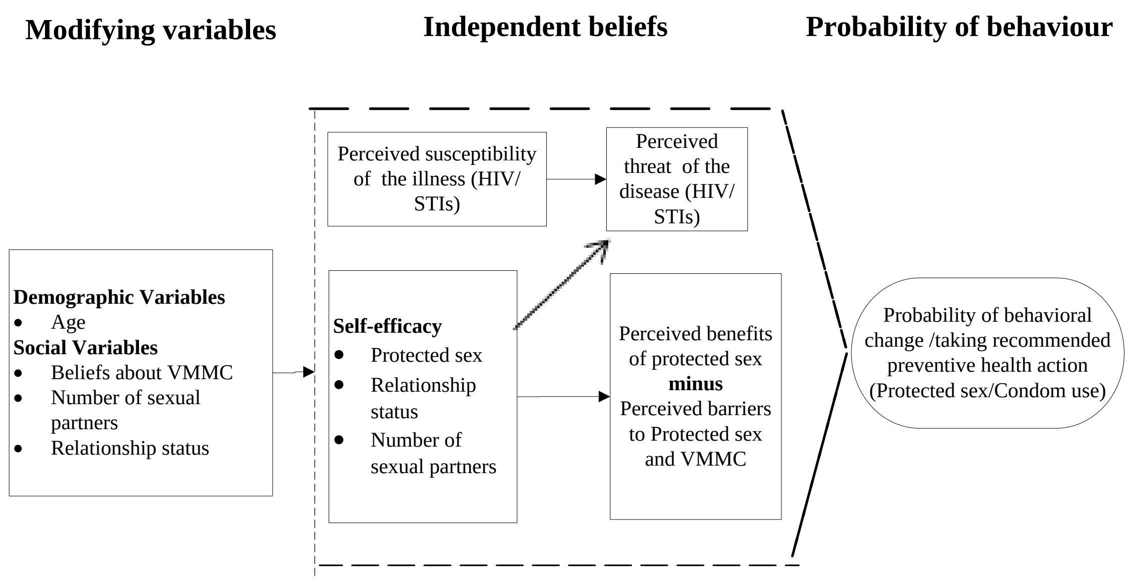


Figure 1. Conceptual model.

Perceived susceptibility is also known as perceived vulnerability. It denotes a person's perception of their susceptibility to illness or acquiring the disease (Glanz et al., 2008; Janz & Becker, 1984; Stretcher & Rosenstock, 1997). For instance, based on the above conceptual framework, an individual must consider that there is a probability of getting HIV or STDs before becoming interested in wanting male circumcision or engaging in protected sex. In many studies, susceptibility has been reported to be the greatest powerful motivator for engaging in health-supporting behaviors (Ramaprasad et al., 2014; Rosenstock, 2000). Perceived severity describes the personal subjective assessment of the degree of seriousness or perceived social impact of contracting the disease concerning the morbidity and mortality rates of the illness (Glanz et al., 2008), such as diagnosing HIV. Perceived severity might indicate the person’s real health literacy, the acceptance or rejection of mythologies, and the attitude about the illness (Ramaprasad et al., 2014). The perceived threat results from the combination between susceptibility and severity of the disease (Glanz et al., 2008).

Perceived benefits denote a person's convictions that a specific act or behavior will be effectual in producing definite positive consequences or advantages (Carpenter, 2010b). Positive consequences would include HIV prevention, financial savings, or pleasing or satisfying other people. Perceived benefit motivates an individual’s confidence in the efficacy of adopting health prevention actions (e.g., circumcision or protected sex) to decrease the chances of HIV infection and avert the undesirable potential health outcomes (Ramaprasad et al., 2014; Tarkang & Zotor, 2015). Whereas perceived barriers suggest the conditions that prevent the individuals’ belief from embracing or engaging in preventive health behavior. The barriers to unprotected sex could include an individual’s opinion of how substantial the emotional or physical pain from circumcision might be, the price of getting the service (VMMC or condoms), unpleasant sexual encounter (using condoms or losing the foreskin), perceived difficulty, or shame or humiliation contingent with the recommended health behavior (Rosenstock, 2005). Janz & Becker (1984) contended that the barriers provide the greatest motivation on adoption of health action. Carpenter (2010) argued that benefits minus the barriers seemed to be the greatest predictors of taking a preventive health behavior.

Therefore, blended degrees of susceptibility and severity may provide the strength to undertake the action, and the awareness of the benefits (minus barriers) offers a favored course of action (Glanz et al., 2008). Ramaprasad et al. (2014) reported a very strong association between susceptibility and action. Ramaprasad et al. indicated that the weaker the perceived severity, the lesser the acceptance of the desired action.

Various early constructions of the HBM incorporated cues to actions that could trigger that readiness(Glanz et al., 2008) and motivate overt behavior to undertake those actions. Cues to action might include events, advertisements, other people, friends, social media campaigns, and any other social networks that could activate or prompt actions or advised health behaviors (Ramaprasad et al., 2014). Although the construct of cues to action is appealing, conversely, it is very complicated and problematic to measure in explanatory surveys (Glanz et al., 2008), and consequently, it was excluded from this research. The self-efficacy concept was included in the later formulations of the HBM as a distinct concept (Rosenstock, Strecher, & Becker, 1988). Self-efficacy describes a person's self-assurance in their capability to choose to implement a recommended action or behavior (Glanz et al., 2008) that is essential to generating the required outcome (Ramaprasad et al., 2014). Self-efficacy was instrumental in assessing the perceived behaviors that influence VMMC uptake and condom use (Glanz et al., 2008).

Table 1. Relationship Between the Independent Variables and Health Belief Model Constructs

HBM Construct	*Variable relationship*	*Description: Nature of variable relationship*
Perceived susceptibility	Belief about VMMC Unprotected sex Number of sexual partners Relationship status	Higher belief on VMMC efficacy could also lead to reduced risk perception amongst circumcised and may lead them to practice risky sexual behavior (i.e., unprotected sex with concurrent sexual partners, or having sex without condoms).
Perceived severity	Belief about VMMC Unprotected sex	When the perceived threat is high, and the belief in the efficacy of VMMC is low, an individual could seek to reduce risky sexual behaviors.
Perceived benefits	Belief about VMMC Unprotected sex	When the belief about VMMC efficacy is high, an individual may want male circumcision for extra protection. The individual may also opt for unprotected sex if he believes VMMC provides full/complete protection.
Perceived barriers	Belief about VMMC Age Relationship status	Relationship status could influence or modify sexual risk behaviors, level of risk perception, and, therefore, may be a barrier to protected sex and wanting VMMC.
Self-efficacy	Unprotected sex Number of sexual partners	High confidence in an individual's ability to effectively insist on partner use of condoms (Condom use self-efficacy) will also increase condom use/ less unprotected sex /have consistent condom use/ have a reduced number of sexual partners.

In this research, I attempted to emphasize only the five HBM constructs and excluded cues to action because they could be easily measured by this study and were likely to show a favorable change. Therefore, for the study, I did not focus on the cues to action construct as with this study, I was not capable of measuring the social network influences. Secondly, these five HBM constructs excellently explained VMMC's motivation and condom use and were used to examine the risk factors for HIV infection. I also used the HBM to assess the behavioral and normative beliefs, their effect on attitude, and consequent influence on an individual's behavioral outcomes, the incentive to comply with using condoms, control beliefs, and apparent power to shun unprotected sex. Further discussions on this theory and conceptual framework appear in chapter 2. The following section provides the statistical design of the study.

Nature of the Study

I used a quantitative approach as a method of inquiry. The design included an explanatory study to identify any association between the study variables relevant to the research problem. For this research, I employed a case-control method to investigate the differences between HIV positive and HIV negative circumcised men regarding their beliefs associated with the false protection of circumcision and related unprotected sexual activities. I began by enrolling participants based upon their present HIV serostatus (HIV positive cases after VMMC and HIV negative controls after VMMC). I preferred to use a case-control study design because it offered the opportunity to examine multiple effects on a single outcome. It also offered more robust evidence than a cross-sectional study (see Andrade, 2015)**,** was able to minimize the recall bias (see Kelly Soler-Hampejsek, Mensch, & Hewett, 2013), and can be used to examine the prevalence of the outcome (HIV status).

Case-control studies are recognized to be efficient and useful for uncovering diseases' etiology with rare outcomes and long induction period between exposure and symptoms (for example, HIV). Finally, considering my study variables where the disease can take longer to acquire, other methods not useful or relevant. Because in a case-control design, all the events (i.e., exposure such as circumcision, unprotected sex, and consequent outcome of interest, HIV positive status) have already happened in the past

(Setia, 2016). I simply collected the data to ascertain the odds of having HIV infection if exposed to a particular risk factor (i.e., belief about VMMC, unprotected sex, age, the number of sexual partners, and relationship status). Although case-control studies are frequently underestimated due to their drawback of being retrospective (Bandera et al., 2013), they offer the most efficient design to ascertain the links between an exposure and an outcome. This quantitative analysis provided a much-needed measurement for the level of association and the outcome.

In this longitudinal case-control study, I collected the past information about the participants. I then assessed the risk factors retrospectively to ascertain their association during the latent period leading up to the current status/subsequent outcome (HIV status), which was coded as 0/1 (no/yes). The next section provides definitions of different or else equivocal terms that were used throughout the following chapters.

Definitions

Belief about VMMC: This refers to individuals' conviction, acceptance, or opinion about protection (partial or full/complete) and or benefits from the VMMC. This variable was measured by how the sampled males appreciated or perceived their susceptibility to HIV and condom use (Wagunda & Agalo, 2016).

Condom use: This refers to subjective assessments on frequency scales (Fonner, Kennedy, O'Reilly, & Sweat, 2014), in addition to the individual's reports on the reliability of condom use throughout a specified period (McKay et al., 2017).

Consistent condom use: Implies to the use of a condom in all sexual encounters (100% of all sexual encounters) or every sexual act (Fonner et al., 2014; Zhang et al.,

2015) of penile-vaginal or insertive anal sex (Rhodes et al., 2017) with either non-marital or non-cohabitant partner in the last one year preceding the survey (Family Health International (FHI360), 2000).

Multiple sexual partners: Infers to having had several sexual partners (higher than one) (Fonner et al., 2014) in the previous 12 months preceding the survey. This was measured via the variable ‘number of sexual partners’ during the last year before the study amongst the sexually active males between 18 and 49 years who were considered to be at risk.

Paid sex: Also referred to as the transactional sex. This refers to the situation whereby one of the partners or both engaging in sexual activity and willing to pay or want to be paid for sex either in cash or in-kind. In this study, all males who will report unprotected sex were asked whether they have ever paid for sex or received a gift (Chikutsa et al., 2015).

Social factors: These are psychosocial characteristics or contextual effects in which individuals were related to each other in a group (Feaster et al., 2011). For this study, the social traits included beliefs about VMMC (perception about partial and complete protection) and relationship status. These social factors will form part of the independent and controlling variables, respectively.

Unprotected sex: This refers to engaging in a higher risk heterosexual activity (vaginal or anal) without precautions, especially a condom, to prevent the spread of sexually transmitted diseases (Nkosi et al., 2015). For this study, unprotected sex was the exposure variable. The information on condom use/nonuse and consistency in the previous 12 months preceding the survey, with different high-risk partners or non-spousal partners were collected.

VMMC: This describes the biomedical intervention which involves the modern surgical removal of all foreskin from the adult male's penis (especially by medically trained doctors or physicians) for intentions of preventing HIV infection (Auvert et al., 2013; Herman-roloff et al., 2012). The prefix 'voluntary' refers to the willingness and lack of coercion of the males participating in the procedure. VMMC status was considered as the exposure variable.

Assumptions, Limitations, Scope, and Delimitations

Assumptions

I assumed that the participants' information contained little social desirability bias and recall bias (McCambridge, Witton, & Elbourne, 2014; Underhill, 2013). The primary data collected was based on self-reported data (Baird et al., 2014), which could have been exposed to social desirability bias. The likelihood of social desirability bias is common when collecting sexual behavior data (Fonner et al., 2014; Underhill, 2013; Zhao et al., 2012). Sexual behavioral questions usually seek participants' responses on attitudes towards or experiences against the social and cultural norms or participants' perception of such behaviors (McCambridge et al., 2014). As a result of shyness, fear, or stigma, the participants may fail to report unprotected sex or other risky sexual behaviors (Rasmussen et al., 2016). This could have led to a biased estimate of the real behavior and conclusions, especially when comparing relative levels of possible high-risk behavior (Thornton, 2012) in different exposure groups.

I reduced the social desirability bias in the design by ensuring confidentiality, building trust, making the participants understand, appreciate the importance of the research objectives, and the harmful significance of giving wrong or imperfect information (Thornton, 2012). I also ensured that the questionnaire design provided clear information on the study objective. Creating rapport to secure participants' cooperation and trust was the most effective way (Visschers et al., 2017). Besides, I did put careful consideration in the framing and ordering sensitive questions in such a way to avoid any possible embarrassment or to discourage interviewers from fabricating responses or in avoiding sensitive questions, or in preventing bias and to give ground to socially deemed favorable answers. Finally, I employed the informal confidential interviewer-administered questionnaire method, which comprised a mix of self-completion and informal, direct face-to-face interview methods.

To reduce the recall bias and enhance the validity of self-reported data, I incorporated techniques that enabled the participants to improve recall. This included providing the participants with anchor dates, timeline-follow-back calendars, and recalling of memorable events throughout the assessment (DiClemente et al., 2013). Additional discussion of how I dealt with self-reported data is in chapter 2.

The second assumption was that due to the convenient sampling, from the post-HIV testing and counseling (HTC) clients, the two groups (exposed and unexposed) were not statistically different throughout observable and unobservable characteristics of participants (Godlonton et al., 2016). I estimated an unbiased measure of the relationship amongst the independent exposure variables and the dependent variable.

Scope and Delimitations

The study examined whether there was any difference between HIV positive (cases) and HIV negative (controls) circumcised males aged between 18-49 years regarding their beliefs associated with the false protection of circumcision and related unprotected sexual activities, within Homa Bay County only. I did not consider the differences in unprotected sex beyond this defined geographical area and age group in the analysis. Therefore, the generalization to populations outside Homa Bay County, Kenya, where risk factors associated with HIV infection may differ, and may not be valid.

Furthermore, I restricted the research to sampling the participants exiting HTC facilities and tests done by qualified staff. Additionally, the study was limited by one outcome factor (HIV status), and I did not consider in the analysis of any other outcome.

Limitations

This case-control study's main limitations could have been due to errors in confounding and bias (recall and selection bias). Confounding could have happened if a third factor may have distorted the association between independent variables and outcome (HIV status), either through the following characteristics: when the factor might have been associated with the independent variable, or with HIV status (outcome), and or when the factor is not an intermediary or moderator on the causal pathway between unprotected sex and having HIV infection (Underhill, 2013). Unmeasured differences between HIV positive and HIV negative could have confounded estimates of the outcome (HIV status) (Auvert et al., 2013). Confounding errors can result in threats to the study’s internal validity. The sensitivity of the nature of sexuality associated with the study could contribute to social desirability bias, resulting in underestimating the incidence and prevalence of unprotected sex.

Another potential limitation, like most of the quasi-experimental designs, this study did not perform proper random sampling; therefore, it may have produced relatively weaker evidence for the outcome. Creswell (2009) argued that the lack of proper randomization could make some statistical tests worthless. Inadequate randomization could increase the probability of variances insignificant variables among the study groups, which may affect or account for the HIV status (outcome). Case-control study designs cannot explain any pre-existing factors and behavioral effects beyond the observation (Baird et al., 2014; Creswell, 2009). This was a limitation in the methodology. Nevertheless, the above limitations do not weaken the study design (Baird et al., 2014; McCambridge et al., 2014).

Strategies to address errors to confounding were taken into consideration to reduce threats to validity. These measures and strategies included using logistic statistical models after the data collection process to explain for their effect and avoid a Type I error (false positive) (Pourhoseingholi et al., 2012). I also looked at the research problem from several perspectives by selecting matching the study populations and research methods simultaneously. Including an unexposed group with matching characteristics of the participant's age group in the study design decreased the threats due to confounding and other unforeseen factors (DiClemente et al., 2013).

There is a probability that selection (or “sampling”) bias could have occurred, primarily when I used non-random sampling methods. To decrease selection bias, I attempted to lower the threats to selectivity by performing proper sampling where necessary and matching participants to specific groupings during data analysis (exposed and unexposed) (Frankfort-Nachmias & Nachmias, 2008). Other factors that could have biased the results, for example, participant attrition and or refusal to participate, were dealt with during the analysis. I achieved this by conducting logistic regression models to examine any unusual differential characteristics between those who accepted to complete the study and the dropouts or those who refused to participate in the survey (Bartholomew et al., 2008). I used Logistic regression models to estimate the odds ratios for each group's descriptive variables (cases and controls) relative to an odds ratio of an individual participant.

In addressing the above limitation due to selection bias and non-random sampling in the design and methodology, I attempted to control for supplementary variables such as age and other features that may affect the results (Wang, 2014). Finally, I tried as much as possible to do random sampling were necessary during the selection of participants (Creswell, 2009), to deliver robust evidence.

Significance

Filling the existing gap in our understanding of unprotected sex

The results of this study could assist males in conducting a self-evaluation of their sexual behavior. It may guide them to determine whether or not they need additional HIV protection (from VMMC, condom use, or both) from HIV or not. By calculating the odds ratio to measure the association between belief about VMMC and other covariates and HIV infection, this study could dispel or confirm the fear that previous studies have not sufficiently ascertained. Therefore, this study could provide more precision in risk estimates and consequent implications on clinical outcomes on the circumcised males in Homa Bay County, Kenya.

The study might provide new information on unprotected sex behaviors in real-life conditions based on more than one behavioral outcome [such as the number of sexual relationships, relationship status, or condom use consistency], or one reported biological outcome [HIV], over a period. The study used a standardized method of measuring and reporting self-reported unprotected sexual behavior concerning various types of partners, both parallel and over a period. The above knowledge to be gained as a result of this research could have a possible impact on the design, implementation, and assessment of sustainable future public health initiative to avert HIV infection, and the possibility for positive social change through the reduction of the burden of new HIV infections.

Positive social change that could emerge from the study

This study could contribute theoretical and empirical foundation for future public health interventions by providing information on the association between the false belief about VMMC and related unprotected sexual activities and HIV infection among circumcised males in Homa Bay County, Kenya. This could aid in designing and communicating careful and accurate information about the actual protection from VMMC. This research could affect social change in numerous ways. It could provide valuable knowledge for researchers and policymakers, which could bring about positive social change in scientific theories and policies that could make a difference in influencing how VMMC programs are implemented in Kenya. For community and health workers, the results could affect change in social behavior and practice. Insights from taking sexual histories outside the clinical settings could inform or help improve clinical practice.

The study could provide data on the magnitude and seriousness of unprotected sex based on the false belief about VMMC in Homa Bay County, Kenya. By providing authoritative data on unprotected sex, this data could be used for calls for action for preventive interventions. This data could also help guide new and existing sexual risk reduction interventions and develop regional strategies that precisely reflect the central concerns determined by the specific regional profile of the problem. Authoritative data on the odds ratio of false belief about VMMC and related unprotected sexual activities and HIV infection could help design highly effective prevention programs and investment in HIV prevention initiatives adapted to respond to the problem. Highly effective sexual risk reduction initiatives adapted to the cognitive levels of the males aged 18 -49 years could prove to be more efficient than a “one-size-fits-all” method or strategy. This could also result in the reduction of wastages in investment in the HIV prevention programs in Kenya.

Summary

The above introduction provided a brief examination of the present situation of understanding the association between risk factors and HIV infection. The inconsistencies and the gaps existing in the existing literature were discussed, with an emphasis on the need for examining behavioral dis-inhibition outside the experimental setting. I concisely explained the use of the health belief model to describe and understand the belief about VMMC and unprotected sex dynamics. I presented a possible approach to ascertaining or dispelling whether there is a difference between HIV positive and HIV negative circumcised males aged between 18-49 years regarding their sexual habits. The chapter also provided definitions for unusual terms and the research questions, hypotheses, assumptions, scope, and limitations for the study. Lastly, I discussed the anticipated positive social change that could result from conducting this research. Additional clarification and explanations are found in the following chapters.

Behavioral disinhibition presents a significant potential risk that could adversely affect VMMC programs' efficacy, notwithstanding the existing inconsistent and extensive body of knowledge from RCT embracing its efficacy. Much remains to be revealed about belief about VMMC, unprotected sex, and HIV infection, and specifically whether or not HIV infection occurs similarly in both groups (cases and controls). This research could yield information on the existence or nonexistence of association between exposure factors for HIV transmission among HIV positive and HIV negative circumcised males in Homa Bay County, Kenya. The expected outcome will be to establish the exposure factors for HIV transmission after controlling for the confounding variables such as place of residence, age, number of sexual relationships, and relationship status. The findings of this research could provide vital information for program implementers, policymakers, and researchers. It could also generate additional areas of inquiry for future research. In supplementing the current understanding of HIV infection, and the possible risk factors, a more thorough and systematic literature review is in chapter 2, while a detailed analysis of the research methods is contained in chapter 3.

Chapter 2: Literature Review

Introduction

Unprotected sex remains a significant public health risk for the people of Homa Bay County, Kenya. The county reported an HIV prevalence rate of 26%, which is second highest and almost 4.5 times greater than the nationwide average (NACC, 2016). In 2015, the County reported about 15,003 new HIV infections, which is among the highest in the country (NASCOP [Kenya], 2016). According to the recent survey, the county reported low condom user rates, with only 52% of males and 60% of females who reported multiple sexual partners used protection during the last sexual intercourse (KNBS & ICF Macro, 2014). Approximately 6% of men in Kenya between 15-49 years recounted having paid (transactional) sex in the last year (NASCOP [Kenya], 2016). NACC (2014) indicated that in the previous decade, more men than women in Kenya reported a rise in multiple sexual relationships. Engaging in multiple sexual relationships places men at a higher risk of HIV infection, mainly if they don't use condoms correctly and consistently (Crosby, 2013).

In 2012, about 35.3 million persons globally had HIV/AIDS, besides 67% of them were from Sub-Saharan Africa (UNAIDS, 2013). And the bulk of new HIV infections in Africa occurs through unprotected heterosexual intercourse (Engedashet et al., 2014; UNAIDS, 2013). UNAIDS (2013) reported that engaging in unprotected sex with numerous sexual relationships continues to be the highest exposing factor for HIV infection in Sub-Saharan Africa. Various research has indicated that male condoms provide the most excellent high-impact strategy with 80–95% efficacy in decreasing the chances of acquiring HIV and other STDs if applied correctly and consistently (Emmanuel et al., 2015). UNFPA, WHO, & UNAIDS (2015) reported that unprotected sex increases the likelihood of acquiring new HIV infection per "penile-vaginal intercourse (PVI) or penile-anal intercourse (PAI)" (McKay et al., 2017) contact. Correct and consistent condom use has so far remained the most effectual way to safeguard against HIV and other STIs (Crosby, 2013; Crosby & Cates, 2012). However, the promotions of VMMC in Sub-Saharan Africa have raised fears of a possible association with increased unprotected sex.

Voluntary Medical Male Circumcision

VMMC is reported to be efficacious in lowering the female-to-male sexual spread of HIV infections (Awad et al., 2017). Evidence from three RCTs done in Kenya, Uganda, and South Africa and observational studies have revealed that VMMC provides partial protection of female-to-male HIV infections by almost 60% (Abbott et al., 2013). In 2007, the WHO suggested that VMMC be introduced as a supplementary HIV prevention strategy in 14 Sub-Saharan Africa countries where HIV is hyperendemic (e.g., with prevalence greater than 15%), with low male circumcision rates (i.e., where more than 80% are uncircumcised), and wherever heterosexual sex is the primary mode of HIV spread (World Health Organization, 2007). Therefore, based on the above criteria, VMMC was to be supported as part of the comprehensive HIV prevention compendium; it was not meant to substitute for other known HIV prevention methods (WHO & UNAIDS, 2007, p.4), including correct and consistent condom use, HIV testing linked to comprehensive care, STI screening and treatment, safe blood transfusion, use of sterile syringes and avoiding "dirty needles," prevention programs with "positives," and use of biomedical prevention methods (Centers for Disease Control and Prevention, 2016).

Suggestions from modeling studies have indicated that universal VMMC could prevent approximately 5.7 million new HIV infections and avert about 3 million deaths in Sub-Saharan Africa in 20 years (World Health Organization, 2007). To achieve this, WHO and UNAIDS (2007) recommended coverage of 44% (about 21 million VMMCs) was required to attain 80% coverage and prevent a projected 3.4 million HIV infections by the year 2025 (World Health Organization., 2015). Inspired by these results and the WHO recommendations, Kenya introduced VMMC in Nyanza, Kenya, as an HIV prevention strategy in 2008 (L'Engle et al., 2014). Since 2008, about 223,435 VMMC cases have been performed in Homa Bay County (Galbraith et al., 2014; NASCOP [Kenya], 2015; NACC, 2014).

Communities in Nyanza province, and Homa Bay, in particular, do not traditionally practice male circumcision (L'Engle et al., 2014; NACC & NASCOP, 2014). Nyanza province has the highest HIV prevalence (14.9%) and the lowest male circumcision prevalence rate (46.4%) in Kenya (NACC, 2016). Evidence from various observational studies (Akullian, Onyango, Klein, Odhiambo, & Bershteyn, 2017; Lawal & Olapade-Olaopa, 2017; Rasmussen et al., 2016) has indicated that generally, regions with a low prevalence of traditionally practiced male circumcision in Sub-Saharan Africa are prone to have higher HIV prevalence.

Belief about Voluntary Medical Male Circumcision and Unprotected sex

Confusions from social marketing concerning the outcome of partial protection of VMMC in Sub-Saharan Africa (Kibira et al., 2016) coupled with advances in HIV treatment, have led to false beliefs among males and females concerning their perceptions of risk of HIV and STD transmission (Sutherland, 2014; Sychareun et al., 2013). Besides, there has been increased concern that VMMC could incentivize a distorted consciousness of security for males involving unprotected sex. This could be a setback to the partial protection offered by VMMC and result in heightened HIV risk (Mbonye et al., 2016; Westercamp et al., 2014). This is because circumcised males and their partners often choose to engage in unprotected sex and/or with multiple concurrent sexual relationships due to perceived reduced risk (Kenyon et al., 2016).

In surveys conducted in Uganda using data from the 2004 and 2011, the Uganda AIDS indicator survey reported a decline in condom use prevalence among the circumcised males (Kibira et al., 2016). Another study conducted in Zambia highlighted a strong relationship between uncircumcised males wanting VMMC and engaging in unprotected sex (Chikutsa et al., 2013).

In this research, I investigated whether there were any relationships between belief about VMMC, unprotected sex, age, number of sexual partners, relationship status, and HIV status among circumcised males aged between 18-49 years in Homa Bay County, Kenya, regarding their beliefs associated with the false protection of VMMC. The following section presents a judicious analysis of the existing literature to ascertain the contemporary situation regarding the possible risk factors for HIV infection. The chapter includes the literature search methodology, theoretical framework, and the study's conceptual model linked to primary study concepts and variables. The last sections are the chapter summary, conclusions, and a transition to the next chapter.

Literature Search Strategy

This section provides a systematic database search conducted to locate high quality and relevant existing evidence of VMMC and the risk factors for HIV infection. The section also includes the catalog of library databases and web-search engines used, the listing of search terms, and the literature review scope employed to methodically seek out and select the literature that met the search incorporation criteria. This systematic search and analytical methodology adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (Moher et al., 2015).

I searched 10 key electronic databases using a list of search engines. These included MEDLINE, CINAHL, PubMed, PsycInfo, MedlinePlus, Cochrane Library, EMBASE, Global Health, Biological Abstracts, and Sociological Abstracts. Also, I manually combed the table of contents of eight essential journals such as *AIDS and Behavior, AIDS, AIDS Education and Prevention, American Journal of Public Health, Health Psychology, Health Education Research & Development, AIDS/HIV,* and *AIDS Care.* I iteratively examined the reference lists and searched all relevant articles taking into consideration the duplicates. For each systematic review, I only included publications from peer-reviewed journals between 2008 and 2017 per inclusion criteria followed by search topics and keywords.

Scope of Literature Review

I used six main inclusion criteria in conducting the literature search. The first criteria were based on the types of studies. I considered different study designs to include relevant evidence, including RCTs, non-RCTs, case-control studies, cohort studies, and cross-sectional studies with a control group and controlled interrupted time series study methods. To incorporating it in the review, every article was specific to VMMC and risk factors for HIV infection, where the outcome was measured before and after the intervention or used multi-arm comparisons (Fonner et al., 2014).

The second inclusion criteria were the health outcomes and outputs of interest to measure behavioral outcomes such as condom use, unprotected sex, and HIV serostatus (Fonner et al., 2014). I only included VMMC studies that examined HIV infection and condom use as primary outcomes in this systematic literature analysis database search. All primary outcomes associated with unprotected sex, irrespective of how they were defined or labeled by the authors (such as unprotected sex, protected sex, safe sex, unsafe sex, and condom use) were included (Fonner et al., 2014). For it to be included, the primary outcome should have contained either a multi-arm (intervention vs. control) or pre/post comparison groups.

The third inclusion criteria were the populations of interest. The search only comprised studies that have included males between 18-49 years, circumcised or uncircumcised, from Sub-Saharan Africa. The fourth inclusion criteria were the data types (primary or secondary data). I considered both primary and secondary research studies. The fifth inclusion criterion was the dates of publication. I only considered peer-reviewed journals from January 2007 through June 2017. The sixth and last inclusion criterion was the publication language, which needed to be English.

This search's exclusion criteria included studies with no specific health intervention and no behavioral health outcomes or outputs. For example, I excluded studies that examined only health risk-factors, VMMC uptake, or condom use. I also excluded review papers and abstracts if the full text was unavailable. Articles not published in English were also excluded (see Volk et al., 2014).

Key Search Terms

The search comprised medical subject headings, free-text terms, and abbreviations, keyword to group concepts, and Boolean operators (AND, OR, and NOT) were used to improve the value of returned searches. For example, (“male circumcision” OR “voluntary medical male circumcision” OR“VMMC”) AND (“behavioral disinhibition” OR “risk compensation” OR “risky sexual behaviors” OR “safe sex” OR “unsafe sex” OR “unprotected sex” OR “protected sex” OR “condom use”) AND (“pre- and post-” OR “before and after” OR “multi-arm comparisons”) AND (“RCTs” OR “randomized control trial” OR “non-RCTs” OR “case-control” OR “prospective cohort” OR “retrospective cohort” OR “cross-sectional” OR “control group” OR “time series”) AND (“health belief model” OR “HBM”) AND “18-49 years” AND “Sub-Saharan Africa.”

The number of documents found and used. The systematic search yielded 44 from MEDLINE, 38 from CINAHL, 29 from PubMed, 17 from PsycInfo, 14 from MedlinePlus, 99 from Cochrane Library, nine from EMBASE, 22 from Global Health, 37 from Biological Abstracts, and 21 from Sociological Abstracts. From the manual search of the table of contents of eight key journals yielded a total of 26 from *AIDS and Behavior*, nine from *AIDS*, seven from the *American Journal of Public Health*, 21 from *AIDS Education and Prevention*, 12 from *Health Education Research & Development*, 14 from *Health Psychology*, 35 from *AIDS/HIV*, and 18 from *AIDS Care.*

Eighty-four articles got through the final inclusion benchmark and were taken into account in the systematic review, which had relevance for the link between imperil factors and HIV infection. Fifty-four studies were identified that assessed VMMC and behavioral disinhibition and 30 original articles that examined VMMC and condom use. Both the RCTs and Non-RCTs reported an average to follow up period of 19 months, demographic health surveys for 5 years apart. In total, the 85 studies examined 146,798 participants fitting the age bracket of males aged between18-49 years. The next section presents a detailed theoretical foundation for the research in addition to the available literature.

Theoretical Foundation

Introduction

Numerous theoretical approaches have been applied in behavioral change and HIV/AIDS intervention research, ranging from individual-level theories to high-level connections theories (Kaufman et al., 2014). The individual-level theories include: The theory of reasoned action (TRA), theory of planned behavior (Ajzen & Madden, 1986), protection motivation theory (PMT), AIDS risk reduction model (ARRM), information-motivation-behavior model (IMBM), and health belief model (HBM), have been applied to comprehend individual self-protective behavioral factors including why some individuals are involved in unprotected sex while others engaged in protected sex.

Health belief model

Theoretical propositions and hypotheses. The HBM postulates that behavior change takes place when three aspects concerning health-supporting actions have to be present. First, an individual must believe in being vulnerable and exposed by their current behavior. Secondly, they must have a positive expectation that a particular change in behavior will be valuable and effective in addressing the condition and resulting in a cherished outcome at an agreeable price. And finally, the person must feel capable of applying the proposed change of behavior or action (Glanz et al., 2002; Rosenstock et al., 1988). The above three aspects are individually significant when assessing change of behavior of VMMC acceptance, condom use, and HIV infection. Notably, an individual must believe that there is a genuine chance, not only statistical, likelihood of getting HIV consequent to their present behavior.

This conceptual model assumes that knowledge of the desired behavior is essential as an intension of enhancing self-protective actions. By intensifying males' knowledge of the health risks linked with unprotected sex, they may be motivated to consider or investigate their behavior (Rosenstock, 2005). However, the capability to persevere and successfully sustenance the desired behavior despite complex and challenging situations may depend on the individuals’ level of self-efficacy (Fonner et al., 2014).

Justification for Choosing the Health Belief Model

HBM has been broadly applied as a theoretical foundation and framework in most health sciences research, and in assessing screening and self-preventive behaviors in particular. An analysis of the Medline database between 1974 and 1994 indicated that over 64% of health behavior research and health promotion interventions had applied the health belief model as a theoretical framework (Ramaprasad et al., 2014). Likewise, the model has also been replicated effectively and successfully many times in health promotion and education (Glanz et al., 2002, 2008; Zhao et al., 2012), and therefore remain the most preferred theoretical framework for this research. I used HBM to assess how the behavioral beliefs and normative beliefs affect attitude towards condoms use. And how they consecutively impact on behavioral outcomes (condom use), incentive and enthusiasm to comply, control beliefs (self-efficacy), and apparent power to avert unprotected sex (Ramaprasad et al., 2014; Tarkang & Zotor, 2015).

The HBM fits well in my conceptual framework that assumes that behavior change begins with the perception and awareness that the individual is at risk of HIV infection (L'Engle et al., 2014). The model postulates that most males receive VMMC due to their perceived vulnerability of HIV infection and alongside the other belief that VMMC will decrease their risk of getting HIV (L'Engle et al., 2014, p.123). This belief about increased protection presented by VMMC could also modify or moderate the risk perception of males and, therefore, influence unprotected sex (L'Engle et al., 2014, p.124). The model further postulates that circumcised males could develop a false belief on the level of protection offered by VMMC and, therefore, could position them at a higher chance of getting HIV infection or other STDs. Likewise, the belief about VMMC could also explain the attitudes towards unprotected sex and intention to get circumcised (Ramaprasad et al., 2014). The following section describes the available literature associated with key variables and concepts concerning belief about VMMC and HIV positive status.

Literature Review Related to Key Variables and Concepts

The literature on the choice of methodology and methods, strengths and weaknesses in previous approaches, and prior findings and rationale for selecting variables are presented in this section. The variable to be discussed in this section will include belief about VMMC, unprotected sex, age, number of sexual partners, relationship status, and their relationship with the dependent variable (HIV status).

Choice of Methodology and Methods

Social desirability bias (including selection bias, recall bias, and observer bias) has been reported to pose a serious threat to sexual health research, owing to some of the interrogations' sensitive and confidential characteristics (McCambridge et al., 2014). Due to social desirability bias or stigma associated with non-adherence to protected sex may prompt individuals to over-report self-protective behaviors, under-report type of sexual encounters they think pleasing or acceptable (Jamison et al., 2013), deliberate misreporting and or poor recall of even of the most recent sexual acts (Chong et al., 2013). However, other research (Weiss et al., 2015) have proposed that accounts on an individual's sexual relationships and behavior can be usually reliable. In reality, responses on some sexual behavioral questions are more reliable when the direct interview method is used than when Audio Computer-Assisted Self-Interviewing (ACASI) is used (Brown et al., 2013). Aarnio & Kulmala (2016) further added that apart from being reliable, self-reported sexual behavioral data is far-off extra sensitive than biological markers.

Fleming et al. (2015) suggested that social desirability bias could be reduced by simplifying the quantitative instruments to capture multifaceted sexual behavior questions or by clearly wording the questions that participants may misunderstand. Other researchers (Craig & Engstrom, 2015; Lippitt, Masterson, Sierra, Davis & White, 2014) suggested the need to build trust among the participants, avoid anonymity, and clarify the participants' purpose and intentions' study, and the importance of providing valuable information. Dadashova, Arenas, Mira, & Aparicio (2014) highlighted the importance of including explanatory models in data collection. According to Dadashova and colleagues, contacting the participants directly and directly administering the questionnaire could also reduce social desirability bias. Direct interviewer administration of questionnaires reduces the cognitive burden inflicted on the participants and increases the study's legitimacy while allowing the interviewer to build rapport and control over the questions.

Strengths and Weakness in Previous Approaches

Previous RCTs done in Sub-Saharan Africa have studied the behavioral response to VMMC and found inadequate or no evidence for behavioral disinhibition amongst circumcised men compared with uncircumcised men (Lawal & Olapade-Olaopa, 2017; Wamai et al., 2012). However, these studies have reported several limitations. The short duration for follow up in RCTs is not sufficient to observe long-term sexual behavioral change post circumcision (Shi et al., 2017). Another limitation of most previous HIV prevention research is the failure to distinguish condom use questions by type relationship (i.e., regular/stable, non-regular/casual, and paid/commercial/transactional sexual partners, Fonner et al., 2014).

Wilson et al. (2014) indicated that most of the above RCTs never disaggregated the behavioral response by the participant's belief about VMMC's protective effect against HIV infection. Various studies (L'Engle et al., 2014; Layer et al., 2013) have indicated high levels of awareness amongst most males in sub-Saharan Africa concerning partial protection and HIV risk. However, the necessity to use protection (condom use) after receiving VMMC is not fully comprehended well by everybody. L'Engle et al. (2014) highlighted that most men reported perceived low HIV risk and less vulnerability to HIV infection consequent to receiving VMMC.

Some of these studies have been criticized for lack of real-life community settings, including limitations to participant response bias (Pitpitan et al., 2015) and selection bias (Westercamp et al., 2014). In the RCT, the participants were regularly monitored, were provided with condoms, and receive intensive regular health education and HIV awareness, and care (Kibira et al., 2016; Westercamp et al., 2014). These could have enhanced the efficacy of VMMC during RCT, a situation that might not be possible to be simulated in natural setups via routine services (L'Engle et al., 2014; Kibira et al., 2016). In contrast, other studies (Kibira et al., 2016; Westercamp et al., 2014) have attributed the lack of evidence of behavioral disinhibition on the intensive and vigorous risk reduction counseling during the trials.

Some of these trials were discontinued prematurely, inhibiting long-standing follow-ups, and evaluating the changes in individual behaviors (Grund & Hennink, 2012; Westercamp et al., 2014). Gong (2015), while citing Baird, Gong, McIntosh, & Özler (2014) provided suggestive evidence that risk reduction counseling seemed to have changed the response bias of re-counting risky sexual behaviors during the successive interviews. According to Gong, this resulted in a possible subjective estimation of the real behavioral variations post-VMMC. Various researchers (Baird et al., 2014; Westercamp et al., 2014) have argued that the RCTs participants obtained excellent preventive counseling standards and care, and therefore, cannot be applied to VMMC scaling-up in the general community settings. In conclusion, most of these findings cannot be generalized beyond the RCT settings (Gray et al., 2012).

Rationale for selection of the variables

For effective measurement of condom use, there is a need to collect adequate information on some of the contextual factors (Crosby & Cates, 2012) and barriers to consistent condom use, such as beliefs about VMMC, age (McKay et al., 2017), number of sexual relationships and relationship status (Rennie et al., 2015). This section describes the rationale of choosing the research variables and the relationship with HIV status (dependent variable).

Belief about VMMC and HIV infection. Various research has indicated that participant's responses to condom related questions may differ with their previous and baseline beliefs about VMMC and risk of HIV infection (Boozer & Philipson, 2000; Gong, 2015). Wilson et al. (2014) tested the behavioral reactions to obtaining VMMC typically by prior personal baseline beliefs and risk of HIV transmission among circumcised and uncircumcised groups. Therefore, Wilson and colleagues suggested that there is a need to assess how unprotected sex and receiving circumcision interacts with baseline beliefs about VMMC. Other studies (Baird et al., 2014; Goldstein et al., 2013) suggested the high likelihood for condom use to be moderated by an individual's baseline beliefs before receiving VMMC.

The response efficacy (level of belief on the amount of protection) post receiving VMMC could also moderate the individual's HIV risk perception and impact their sexual behavior (L'Engle et al., 2014). When circumcised males think that they have 100% protection from HIV risk after VMMC, they could involve in risky sexual behaviors since they may observe themselves to be no longer have any likelihood of HIV infection (p.128). Wilson et al. (2014) developed empirical modeling and equation that emphasized the role of beliefs in the causal process in behavioral disinhibition. This empirical modeling assumed that belief status is never changing with time and does not change inversely by circumcision status (Wilson et al., 2014, p.10).

There have been reported misconceptions due to social desirability among the circumcised males and their partners on the level of protection provided by VMMC against HIV transmission and the decreased risk of other STDs (Humphries, van Rooyen, Knight, Barnabas, & Celum, 2015). Layer et al. (2013) contended that this overstated belief in the overall public health benefits provided by VMMC could conceive a situation whereby women may be involved in unprotected sex with circumcised men. Abbott et al. (2013) reported that circumcised men were using their circumcision status to convince female sex workers to surrender condom use due to the perceived heightened protection provided by circumcision. Another research done in KwaZulu-Natal, South Africa, denoted that some circumcised males understood that their circumcision status allowed them to have multiple sexual partners, and extra sex. They also believed that VMMC provided them with adequate protection from HIV risk and therefore condoms could only be required to prevent pregnancy (Humphries et al., 2015).

Grund & Hennink (2012) suggested the need for effective male circumcision counseling for alleviating HIV risk behaviors as VMMC gains impetus as a possible HIV prevention mechanism. However, fostering protective sexual behavior change among men should be a priority. In comparison, other researchers have recommended the urgent need to develop a communications strategy to tackle the misconceptions about the belief about VMMC and encourage HIV protective methods. Interventions promoting the abstinence among recently circumcised men and none risky sexual behaviors (L'Engle et al., 2014) are significant in attaining the strategy of “getting to zero” of new HIV infections (Kamath & Limaye, 2015).

Wagunda & Agalo (2016) reported that VMMC was introduced in some parts in Kenya as a substitute plan for inconsistent condom use. Therefore it has led to a propensity towards behavioral disinhibition. Moreover, even those who considered themselves to be susceptible to HIV risk never used condoms consistently after being circumcised (Wagunda & Agalo, 2016, p.24). The role played by belief about VMMC in HIV risk perception has been documented in various studies (Gurman, Dhillon, Greene, Khumlao, & Shekhar, 2015; Wagunda & Agalo, 2016). However, there is inadequate data available explaining the role it plays in the association with HIV infection. There are also limited VMMC studies examining behavioral disinhibition conducted in Sub-Saharan Africa and, specifically in Kenya, have attempted to assess the role of belief about VMMC on female-to-male HIV transmission. Also, the few that attempted failed to include the baseline belief about VMMC in the association. Therefore, this gap called for further studies to assess the effect of belief about VMMC on HIV infection. This study provided additional research to ascertain whether baseline beliefs about VMMC influence and or moderate with unprotected sex in HIV infection.

VMMC, unprotected sex, and HIV infection. A study conducted in Zambia significantly linked the desire for circumcision with risky sex, paid sex, having multiple partners, and men from higher wealth tercile (Chikutsa et al., 2015). Chikutsa and colleagues also reported that wanting circumcision was positively linked with unprotected sex at the last risky sex. Odoyo-June Elijah, Rogers H., Jaoko, & Bailey (2013), while citing Agot et al. (2007), indicated that males opting for VMMC were 79% highly likely to have exhibited unprotected sex in the last three months preceding to study entry compared to those who opted to stay uncircumcised. Kibira et al. (2016) reported a higher prevalence of risky sexual behaviors amongst circumcised males. Kibira et al. also linked circumcised males with a decline in condom use, a higher number of sexual relationships, and non-marital relationships compared to uncircumcised males (Kibira et al., 2016, p.7).

Three RCTs conducted in Kenya, South Africa, and Uganda delivered conflicting evidence on the link between VMMC and risky sexual behaviors. The study conducted in

Kenya reported a sharp decrease in the perception of higher HIV risk amongst circumcised males (from 30% to 14%) and a higher rise in condom use at last sex when contrasted to uncircumcised men (30% vs. 6%; Westercamp et al., 2014). L'Engle et al. (2014)have further reinforced these results. They argued that circumcised males continued to use condoms due to their high level of awareness of partial protection and the belief that VMMC would modestly decrease their HIV risk. Likewise, the study in Uganda reported no increase in risky sexual behaviors (Gray et al., 2012). While another RCT conducted in Orange Farm, South Africa, they have indicated increased risky sexual behaviors among circumcised males (Auvert et al., 2013).

Wilson et al. (2014) reported the absence of any differences in condom use in the short term between circumcised believers and circumcised non-believers. However, Wilson and colleagues indicated a significant rise in condom use after one year, amongst circumcised believers. George, Govender, Beckett, Montague, & Frohlich (2016) and Westercamp et al. (2014) argued that circumcised males engaging in riskier sex are considered as early adopters of VMMC. According to George and colleagues, this was a temporal behavior that will disappear in the long run (after one year).

Grund & Hennink (2012) indicated the fear that VMMC could be both protective and risky for HIV transmission. Some circumcised men considered themselves to be equipped with an ‘‘invisible condom’’ (Westercamp et al., 2014) and, therefore, are ostensible to have unprotected sex, and their partners lesser able to bargain for condom use (Crosby, 2013; Crosby et al., 2012). Another study conducted in Botswana reported that unprotected sex is more common among circumcised males compared to uncircumcised males (Rennie et al., 2015). While in another research done in Kenya, Galbraith et al. (2014) reported that only 21% reported condom use at last sex among uncircumcised males who were HIV negative.

The majority of these RCTs studies performed in Kenya (Westercamp et al., 2014), Uganda (Gray et al., 2012), Zambia (Abbott et al., 2013), and Zimbabwe (Chikutsa et al., 2015) established no evidence of behavioral disinhibition following VMMC. However, some of these RCTs reported higher levels of non-condom use and multiple sexual relationships amongst the circumcised group compared with the uncircumcised (control) group at baseline (Hewett et al., 2012), while some reported risky behaviors (Auvert et al., 2013; Gray et al., 2012; Grund & Hennink, 2012). Whereas studies conducted in Orange Farm, South Africa (Auvert et al., 2013), Uganda (Kibira et al., 2016), and Swaziland (Grund & Hennink, 2012) indicated that circumcised males engaged ostensibly in risky sexual behaviors when contrasted to uncircumcised men. However, Kibira et al. (2016) and Westercamp et al. (2014) did not observe similar findings of risky sexual behaviors in the Ugandan and Kenyan RCTs, respectively. The bulk of previous research examining circumcision status and unprotected sex were RCTs, and they have indicated more considerable variability and conflicting results (L'Engle et al., 2014; Westercamp et al., 2014; Wilson et al., 2014). Notwithstanding, limited information is acknowledged about the prevalence of unprotected sex amongst the general population of circumcised men in Homa Bay Country. This study's objective was to ascertain whether beliefs associated with the false protection of circumcision influences HIV infection. Secondly, to examine whether there existed some contextual differences in the associations between HIV positive and HIV negative circumcised males in Homa Bay County, Kenya.

Age and HIV infection. Age and other personal characteristics act as modifying factors to self-protective behaviors and utilization of public health services in general (Prati et al., 2015). Paterno & Jordan (2012) argued that unprotected sex increases with an increase in age. Prati et al. (2015) reported that condoms are used mostly by those who are relatively younger. While other studies (McKay et al., 2017; Rennie et al., 2015) have also indicated that condom use declines with age. Age, as part of the social gradient and blended with beliefs in vulnerability and benefits, has been significantly linked with unprotected sexual acts (Prati et al., 2015). The age variable is a significant determinant of unprotected sex and has been incorporated in this research. The demographic health survey provided the generalized data for condom use distribution by age for the Nyanza region (KNBS & ICF Macro, 2014). Despite this, there exists no context-specific data for unprotected sex by age in Homa Bay County, Kenya.

The number of sexual partners and HIV infection. Generally, the rate of protected sex in Sub-Saharan Africa is very low, with less than 50% stated condom use at last sex amongst males with numerous sexual relationships (UNAIDS, 2016). Smith et al. (2014) reported that in Sub Saharan Africa, multiple sexual relations is the primary driver of heterosexual HIV transmissions. Chikutsa & Maharaj (2015) explained this phenomenon through a qualitative study to explain why some males tend to have numerous sexual relationships and, altogether, do not see the need to use condoms after circumcision.

Fonner et al. (2014) heightened the importance of collecting other sexual behavioral dimensions, such as sexual activeness, before examining condom uses. The researcher can establish the sexual activeness of the participant by asking questions on the number of sexual relationships within a specified period. Those who report none can be classified as abstinent and therefore have a potential of reduced exposure to HIV risk. Furthermore, a few studies have failed to exclude sexually inactive participants during analysis; therefore, misclassifying them as non-condom users (Fonner et al., 2014). There exist various literature on the concurrent multiple sexual partners and HIV epidemics in the USA (Ashenhurst et al., 2015; Newcomb et al., 2014), Africa (Chialepeh & Sathiyasusuman, 2015), and Sub-Saharan Africa (Onoya et al., 2017). However, there is limited data, and it remains unclear whether there is any link between the number of sexual partners and HIV infection, and whether this relationship differed by HIV status.

Relationship status and HIV infection. Rennie et al. (2015) indicated that condom use declines with marital status (i.e., married or stable relationships). A married person is 2.68 times highly likely to have unprotected sex contrasted to unmarried individuals (Alamrew et al., 2013). McKay et al. (2017) also indicated that unmarried individuals tend to have multiple sexual relations compared to married ones. Therefore, the marital status of the individual is essential for inclusion in this research. The Kenya demographic health survey provides the latest data on condom use distribution by marital status in Kenya (KNBS & ICF Macro, 2014). Nevertheless, this data is for the general population in Kenya and is not disaggregated by counties.

Macintyre et al. (2014) and Monsell & McLuskey (2016) indicated that relationship status is associated with condom use. Individuals who were in stable or marital relationships have a high likelihood of reporting non-condom use due to their perceived low risk of HIV infection (Monsell & McLuskey, 2016; Muchiri et al., 2017).

Apart from indicators measuring condom use at last sex and consistency, other research (Fonner et al., 2014) had also suggested the need to include a third indicator that can measure the frequency of sexual acts by relationship status and the reliability of condom use by relationship status. This information can aid in calculating the proportion of unprotected sexual acts by subdividing the total number of sexual acts by the total number of unprotected sexual acts. The majority of studies that have examined unprotected sex and concurrent sexual partnerships have ignored to include the analysis by partner relationship status (Fleming et al., 2015; Kretzschmar & Caraël, 2012), despite the role played by relationship status on unprotected sex. And to the best of my knowledge, no literature exists that examines the belief about VMMC, relationship status, unprotected sex, and HIV infection and whether this relationship differed by HIV status in Homa Bay County, Kenya.

Summary and Conclusions

Various research (Gray et al., 2012; Underhill, 2013; Westercamp et al., 2014), have indicated the fear of the possible risk of behavioral disinhibition among males who have received circumcision as one of the biomedical HIV prevention strategies. The above literature review has revealed available knowledge on the concepts for analyzing the possible links between belief about VMMC, unprotected sex, age, number of sexual partners, and relationship status with HIV infection. Specifically, the literature review has analyzed various study variables, including their relevance to this study. The literature review has also reviewed the limitations of previous studies and gaps that this research attempted to address.

Whether there is any significant association between VMMC and behavioral disinhibition remains to be answered and requires continuous monitoring. The promotion of VMMC for HIV prevention strategy should be treated with extreme caution. Westercamp et al. (2014) concluded that behavioral disinhibition issues should not hinder the extensive scaling-up of VMMC initiatives, especially in lessening the spread and burden of HIV transmission in Africa. VMMC has been linked with a higher prevalence of unprotected sexual behaviors. HIV prevalence remained low amongst circumcised males (Kibira et al., 2016), indicating that VMMC provides some degree of protection from HIV infection (Auvert et al., 2013).

The HBM theory postulate that behavioral change begins with the belief that an individual is susceptible to a risky health outcome (L'Engle et al., 2014; Tarkang & Zotor, 2015). Concerning VMMC, males are inspired to obtain circumcision, mostly due to the perceived risk of HIV infection and the additional belief that obtaining VMMC may decrease their chances of getting HIV (L'Engle et al., 2014). Ramaprasad et al. (2014) argued that all the variables in the HBM helped explain attitude and intention to get circumcised. Carpenter (2010) found out that among the HBM constructs, perceived benefits minus perceived barriers were reliably the most significant predictors of protected sex.

A Serious gap in our knowledge of risk factor for HIV infection

There exists limited published research available that have examined the relationship between belief about VMMC and unprotected sex in Africa. Nearly all the existing studies investigated the association between VMMC and risk compensation and or behavioral disinhibition using RCTs. These RCTs have presented inconsistent, contrasting, and inconclusive empirical evidence (Auvert et al., 2013; Gray et al., 2012; Grund & Hennink, 2012; Westercamp et al., 2014). They have attempted to measure the changes in sexual behavior through hypothetical models and behavioral assessments (Auvert et al., 2013; Gray et al., 2012; Kong et al., 2012), of which unprotected sex is one of the individual belief schemes for the overall risk (Westercamp et al., 2014). Likewise, other studies have attempted to measure the risk equilibrium as a snapshot of the whole individual risk belief (Westercamp et al., 2014. p.1009). These measurements have failed to yield reliable analysis and conclusion because the situational factors at any point in time are dynamic, and risk levels keep on changing post-VMMC (Westercamp et al., 2014, p.1010).

Westercamp et al. (2014) cautioned the interpretation of the lack of evidence from the above studies on behavioral disinhibition. There have been many debates that have suggested additional research beyond the experimental settings (Weiss et al., 2015). There are limited studies conducted beyond the three RCTs (Abbott et al., 2013; Rennie et al., 2015; Westercamp et al., 2014) that have investigated the association between VMMC and unprotected sex, and especially in Homa Bay County, Kenya.

Whereas considerable studies have been done concerning the preventive behavior of condom use (Giannou et al., 2016; NASCOP, 2014; Westercamp et al., 2014), there exist limited research conducted outside the experimental setup on the self-protective behavior of receiving VMMC (Pitpitan et al., 2015; Westercamp et al., 2014). There is also limited research that has examined whether the false belief about the level of protection offered by VMMC could be a risk to HIV infection. Likewise, the bulk of previous research conducted was among young people (15-24 years) (McKay et al., 2017). Therefore, there is a need to further research on beliefs associated with the false protection of VMMC in HIV infection, both young and midlife adults controlling for the unprotected sex, age, number of sexual partners, and relationship status.

Above-mentioned RCTs studies have also provided mixed results, and therefore, warrants for further research to provide conclusive evidence to ascertain the main risk factors for HIV infection. Previous studies have used the simple four-variable additive HBM model (Ramaprasad et al., 2014). There is a serious gap with the above four-variable additive HBM model in addressing the relationship between the belief about VMMC and HIV status. The study also evaluated if there were any possible mediation and moderation among the HBM variables (Carpenter, 2010a) in the assessment of the possibility of belief about VMMC being a risk factor to HIV infection due to the false beliefs on the protection from VMMC (Baird et al., 2014). In this research, I used objective outcome measures within HIV infection to test the study hypotheses. In particular, the study answered the question: What are the differences between belief about VMMC, unprotected sex, age, number of sexual partners, relationship status, and

HIV status among circumcised males aged between 18-49 years in Homa Bay County, Kenya?

The next chapter presents the study methodology, sampling techniques, and analytic techniques. It gives an account of the study population's specifics, study variables, threat to external and internal validity, and ethical concerns.

Chapter 3: Research Method

Introduction

This study examined whether there were any differences between HIV positive (cases) and HIV negative (controls) with circumcised males aged between 18-49 years regarding their beliefs associated with the false protection of circumcision and related unprotected sexual activities in Homa Bay County, Kenya. Using a case-control design, I examined the relationship between independent and outcome variables. In this chapter, I describe the research design, rationale, and methodology of the study, including setting, target population, sampling strategy, recruitment process, participation criteria, and methods for data collection. Additionally, I describe the instrumentation and operationalization of key constructs and variables, illustrate the plan for data analysis, discuss how I addressed the threats to validity and the ethical procedures.

Research Design and Rationale

The dependent variable was HIV status, which was coded as 0/1 (no/yes) in both groups. The independent variable was beliefs about VMMC (perception about partial and full/complete protection). The controlling variables were unprotected sex, age, number of sexual partners, and relationship status.

Table 2. Relationship Between the Theoretical Framework, Study Variables, and Justification

HBM construct	Variable relationship	Explanation/justification
Perceived susceptibility	HIV Status (positive - no/yes) Belief about VMMC Unprotected sex Number of sexual partners Relationship status	• Individual's risk perception of HIV infection (risk of becoming HIV-positive and or acquiring sexually transmitted diseases (STDs) (no/yes)). When the perceived risk is high, an individual may opt for VMMC or condoms for extra protection. • The higher belief in VMMC efficacy could also lead to reduced risk severity amongst the circumcised. It may lead them to practice unprotected sex, with high-risk sexual partners, having multiple sexual relationships.
Perceived severity	Belief about VMMC HIV + (no/yes) Unprotected sex.	• When the perceived threat is high, and the belief in the efficacy of VMMC is low, an individual could seek to reduce risky sexual behaviors. • When the perceived threat of getting infected with HIV is low (in terms of individual evaluation of the possible consequences -including financial, biomedical, and social of pregnancy, acquiring STDs, HIV, and AIDS), an individual may engage in risky sexual behaviors (i.e., unprotected sex).
Perceived benefits	Belief about VMMC Unprotected sex, HIV + (no/yes)	• When the belief about VMMC efficacy is high, an individual may want male circumcision for extra protection. This could result in a high possibility of engaging in unprotected sex. • When the perceived value or positive aspect of engaging in protected sex with risky sexual partners (to avoid HIV/AIDS and STDs) is high, an individual could reduce risky sexual behaviors.
Perceived barriers	Belief about VMMC, HIV + (no/yes) Age, Relationship status.	• High perception of VMMC efficacy and circumcision status could act as a barrier to protected sex. • Perceived barriers related to wanting circumcision or protected sex may include relationship matters and emotional/psychological stress related to condom use/non-use: such decreased pleasure and reduced sensation in addition to concerns about adverse reactions from partners, pain, cost, etc. • Age and relationship status could influence or modify sexual risk behaviors, level of risk perception, number of sexual partners, and, therefore, may be a barrier to protected sex and wanting VMMC.

HBM construct	Variable relationship	Explanation/justification
Self-efficacy	Unprotected sex, Number of sexual partners	• High confidence in an individual's ability to effectively insist on partner use of condoms (Condom use self-efficacy) will also increase condom use/ less unprotected sex /have consistent condom use. • High self-efficacy could also decrease the number of sexual relationships, frequency of sexual acts, a high belief about VMMC efficacy, and the type of relationships one has.

I used the quantitative approach and employed a case-control method to establish whether the beliefs associated with the false protection of circumcision and related unprotected sexual activities are risk factors for HIV infection amongst circumcised males in Homa Bay County, Kenya. I examined retrospectively unprotected sex and other covariates during the last 12 months. All males presenting for the HIV testing program in nineteen VCT/HTC facilities were notified about the study and screened for eligibility (both cases and controls). All consenting eligible circumcised males were asked questions about their demographics and behavioral risks for the past 12 months using an interviewer-administered questionnaire survey focusing primarily on self-reported circumcision status, belief about VMMC, HIV test results, unprotected sex, age, number of sexual partners, and relationship status to characterize them by HIV incidence and sexual risk behaviors. In a case-control study design, all the events have already happened in the past (Setia, 2016). The objective was to establish two groups based on HIV status (cases and controls). I then examined the association between the exposure (belief about VMMC, engaging in unprotected sex, age, number of sexual partners, and relationship status) and HIV status, thereby calculating the odds ratio in each group and, ultimately, the measure of association of this study design. I did this to ascertain the probability of the outcome (HIV status), which was coded as 0/1 (no/yes) in both groups. The design employed the HBM, which has been used by various studies to predict sexual health behaviors (Bernard & Wang, 2013). The HBM constructs also provided links between condom use self-efficacy, avoidance of unprotected sex, and HIV infection (negative health outcome; Ramaprasad et al., 2014).

I preferred to use a case-control study design because it (a) offered the opportunity to examine multiple effects of a single outcome (see Bandera et al., 2013), (b) helped to minimize the recall bias (Kelly et al., 2013), and (c) could be used to examine the prevalence of the outcome (HIV status). Although case-control studies are frequently underestimated due to their drawback of being retrospective (Bandera et al., 2013), they offer the most effective design to ascertain the links between an exposure and an outcome. This quantitative analysis provided a much-needed measurement for the level of association and the outcome. The other rationale for the choice of the design was that it offered a low-cost and short time frame for data collection compared to prospective cohort studies. The design provided a detailed view of the phenomenon (HIV status) in real-time. Finally, it also offered prevalence information that could be inferred and generalized over a protracted period (Reed, 2015).

Methodology

Study Setting and Population

Homa Bay County is located in the southern part of the former Nyanza Province, Kenya. Based on the 2017 Kenya Population and Housing Census projections, the county has an approximate population of 1.6 million persons UNAIDS, 2019). The county comprises eight sub-counties: Kabondo, Kasipul, Karachuonyo, Homa Bay Town, Rangwe, Mbita, Ndhiwa, and Suba (County Government of Homa-Bay, 2015). Being located along Lake Victoria, there is high mobility, the migratory status of fisher folks, and a high prevalence of commercial sex ("fish for sex") along the beaches, contributing to the sustained HIV pandemic in the region (Kiwanuka et al., 2014).

The bulk of the RCTs on HIV and VMMC research conducted in Kenya were done in Kisumu and Siaya Counties, and there is no evidence that a comparable study had been carried in Homa Bay County, hence the reason for the population chosen for this study. This study added to the current state of science, and it is much needed in Homa Bay County, Kenya, because the county has the highest adult HIV prevalence rate (26%) in Kenya. This prevalence rate is almost 4.5 times higher than the nationwide average (NACC, 2016). In 2015, the county reported 15,003 new HIV infections (NASCOP, 2016). The communities in the county are predominantly Luo and Suba ethnic communities who never traditionally practiced circumcision until the introduction of VMMC; therefore, Homa Bay County has the lowest VMMC prevalence rates in the country at 56%, compared to 92.6% nationally (KNBS & ICF Macro, 2014). The county has reported a rise in circumcision rates from 17% in 2003 to 56% in 2012 due to the scale-up of VMMC campaigns (KNBS & ICF Macro, 2014, p. 241).

For this study, I recruited circumcised males aged 18-49 years from clients visiting 19 HTC facilities selected from eight sub-counties in Homa Bay County, Kenya. Other characteristics of the population were not known before recruitment. The approximate population size of males aged between 18-49 years in Homa Bay County, Kenya, is 175,646 (Kabondo Kasipul, 28,363; Kasipul, 11,487; Karachuonyo, 29,644; Homa Bay Town, 16,378; Ndhiwa, 31,126; Rangwe, 18,700; Mbita, 20,868; and Suba, 19,081; KNBS, 2010). The choice of this age range (18-49 years) was to maximize the likelihood of the sexually active male population.

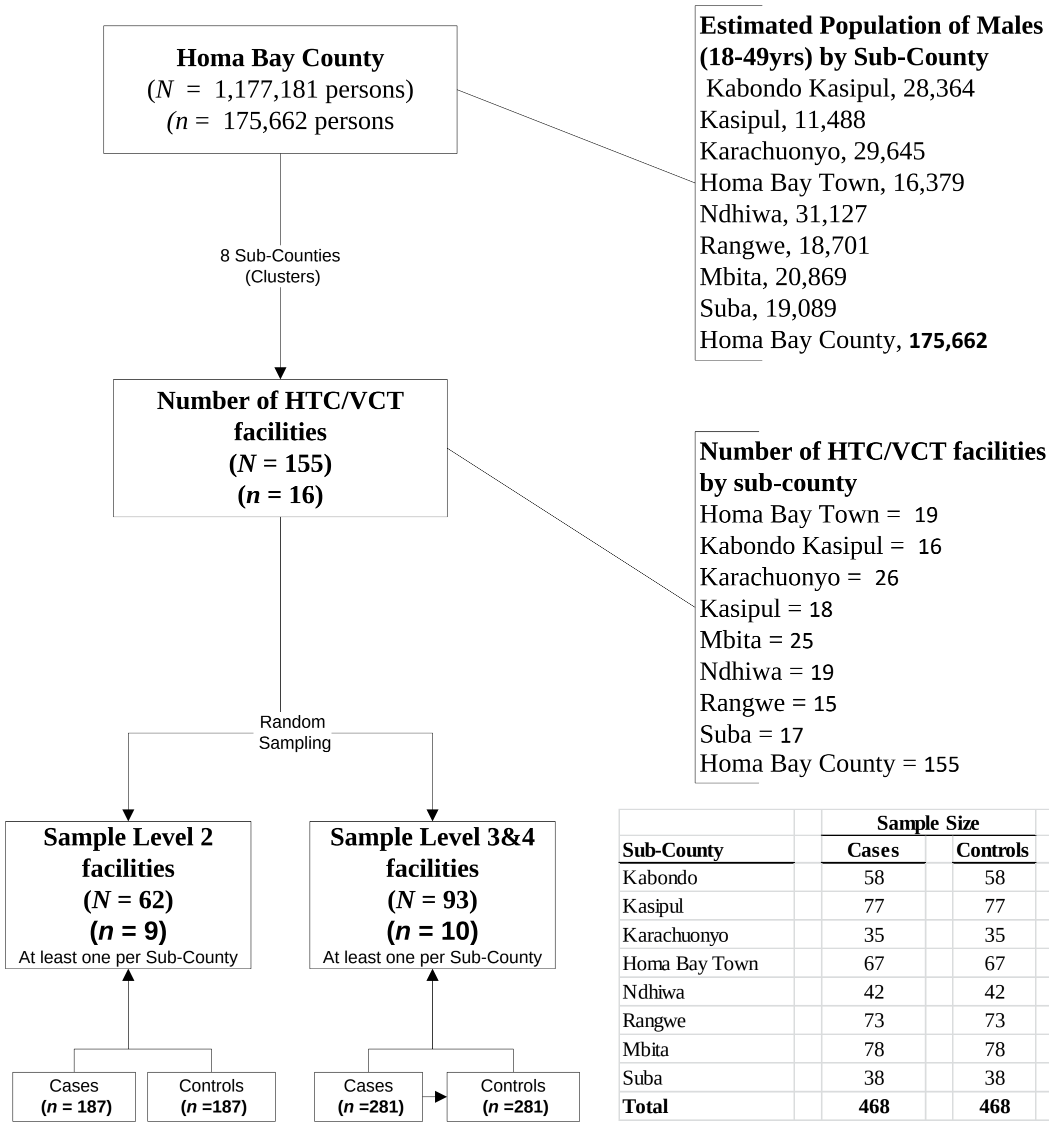
The Kenya Demographic Health Survey report indicated that about 23% of men aged between 15-49 years received an HIV test in the previous year (KNBS & ICF Macro, 2014). In contrast, reports by NASCOP indicated that 75% of males in Homa Bay have ever tested for HIV as opposed to the national average of 72% (NASCOP, 2017). The annual HIV tests conducted in Homa Bay County, Kenya, in 2014 was for 229,972 people, which is about 20.4% of the county population (Government of Kenya Ministry of Health, 2015), hence providing an adequate sample.

Sampling and Sampling Procedures

Sampling strategy and procedure. I applied incidence density sampling (also known as risk set sampling) within 19 dynamic population base sites to recruit participants for the case-control study. Incidence density sampling involved automatic matching based on calendar period (for example, a control was chosen from the underlying same at-risk population base each time I observed a case). I divided the County population into administrative sub-counties. First, I used the Ministry of Health facility clustering in Homa Bay County, Kenya (which falls between Level 2 and 5), to stratify the HTC/VCT facilities. From each sub-county, I used the HTC/VCT facility list to randomly select at least one site, each at lower and higher levels. The County Ministry of Health Office provided the list of facilities. To be included, the facility must have had a counselor or nurse certified by the Ministry of Health to conduct rapid HIV tests (Baird et al., 2014). This sampling was performed in the presence of an independent person, preferably a management representative from each sub-county. And all the facilities in each sub-county had an equal likelihood of being sampled in the study.

The next step was to apply the incidence density sampling technique by matching the participants based on a similar time when the cases were identified. Cases were circumcised males with newly diagnosed HIV positive serostatus recruited from the clients exiting HTC/VCT facility (study base) for routine HIV testing services. While the controls were circumcised males with newly diagnosed HIV negative serostatus selected from those exiting the same study base (HTC/VCT facility) that gave rise to the study cases. I explained to all prospective participants about the study before screening them for eligibility for the inclusion criteria before being registered to participate in the study. The recruitment continued until a required sample was attained. The number of cases and controls chosen from each sub-county and facility was proportionate to the sub-county population size.

Each time a case was identified, one control was selected randomly or conveniently from the base population (sampled HTC/VCT facility- person-time of the same population at risk) who, at that point in time, had been diagnosed HIV negative. I randomly sampled the cases if there were many cases on a given day; otherwise, I took everybody who met the inclusion criteria that day. Likewise, controls were randomly sampled or all taken depending on numbers seen on that particular day. Therefore, the incidence of new cases governed the eligible number of controls recruited until the required sample size was achieved. A deliberate attempt was made to ensure that all participants were sampled independently, irrespective of their exposure status (Bandera et al., 2013).



	Sample Size		
Sub-County	**Cases**	**Controls**	**Total**
Kabondo	58	58	**116**
Kasipul	77	77	**154**
Karachuonyo	35	35	**70**
Homa Bay Town	67	67	**134**
Ndhiwa	42	42	**84**
Rangwe	73	73	**146**
Mbita	78	78	**156**
Suba	38	38	**76**
Total	**468**	**468**	**936**

Note
N = the number of elements in the dynamic base population
n = the number of elements selected in a random sample or incident density sampling

Figure 2. Diagrammatic structure of incidence density sampling.

Incidence density sampling was an ideal technique as it was able to produce an odds ratio that accurately estimated the incidence rate ratio because the sampling technique was grounded on person-time exposure. Besides, there are many advantages to selecting the facility-based controls. They may reduce the chances of selection bias because the participants usually come from the same base population (especially if the motivations and referral patterns are alike). They also share specific selective factors that make them seek the services in that facility (e.g., wealth status, location, ethnicity, or similar referral patterns and or social norms). Thus, selecting controls from the same group of participants that produced the cases may decrease the effect of these factors.

Furthermore, they may have experienced the same reasons for seeking HIV testing and share the same characteristics with the cases regarding their trend of completing the questionnaire (i.e., the level of accuracy of information provided). This sampling method may decrease the possible differences between the groups (cases and controls), especially on their historical recall of exposures, hence minimizing recall bias. Lastly, when the sampling of controls was randomly selected based on person-time, the sampling of controls delivered a similar estimate of a relationship between the predictors and study outcome, data that one would get if all participants were followed up until the end.

Sampling frame. Facilities included in the base population were only those who performed more than 10 HIV HTC/VCT tests per day to offer a reasonable sampling frame. Eligible participants were circumcised males (screened for only those who were circumcised no less than six months preceding the study registration and must have been HIV negative before circumcision). Only those that have received an HIV test during the survey period knew their HIV serostatus and were willing to share the test results were included. They must have been aged between 18-49 years and residing within the sub-county. Only sexually active participants were included. Must have been physically fit/ not too ill to cooperate and or psychologically stable. Only those who were willing to participate in the study were included, and all refusals were recorded. The HIV status was only verified using the participant's self-reported information. The self-reported HIV status was based on the standardized tests from a health facility with robust psychometric characteristics that admitted for comparability of universal measures crosswise in different study populations, ensuring greater measurement validity (Johnson & Christensen, 2015). I triangulated the self-reported HIV status with verification of the test results. Those who refused to share their test results slip for verification were excluded from the study and were recorded.

The following exclusion criteria were applied: Facilities that performed less than 10 HIV VCT/HTC tests per day were excluded from the random sampling. Males not falling within the age bracket 18-49 years and or not residing within the sub-county were excluded. Males circumcised within six months before the study were excluded. Those who received traditional, child, or infant male circumcision were not included in the study. Potential participants who were HIV positive before circumcision were also excluded. Those who refused to disclose their HIV status test results were also excluded from participation. Individuals who were not sexually active in the last year preceding the survey were also excluded. Mentally and emotionally disabled individuals or with psychological distress were not included. Lastly, those who were not willing to participate in the study were also excluded.

A previous study by Peltzer et al. (2013) indicated that there are no significant differences with age, sex, education, marital status, and wealth according to where HTC/VCT clients receive their HIV tests. About 155 facilities were providing HIV testing services in Homa Bay County, Kenya. The average total number of HTC/VCT clients who came for HTC in one month was estimated to be 324 clients for Level 4 and 5; 132 clients for Level 2 and 3. This translated to a daily average of 15 clients for Level 4 and 5 and 7 clients for Level 2 and 3.

Sample size. I used EPI INFO 7.10 statistical calculator and Schlesselman and Stolley's approach (Burkholder, 2012; Stolley & Schlesselman, 1982) in calculating the sample size. The sample size calculation was decided and grounded on certain fundamental principles: confidence level (95% Two-sided Confidence level to increase the rejection region), statistical power 90% (to detect a real association amongst the section of unprotected sex reporting HIV+), the ratio of control to cases of 1, percentage of exposure among the control (p) 52% (prevalence of unprotected sex) (KNBS & ICF Macro, 2014), and odds ratio of 1.59 (based on the previous study) (Bachanas et al., 2016). The statistical calculator generated 840 participants, 420 cases, and 420 controls (Fleiss with continuity correction factor [w/CC]). At a prevalence (p) of 52%, Schlesselman and Stolley's formula provides the largest sample size achievable due to the maximum variance, p(1_p), thereby boosting the study's power and decreasing the possibilities of type II error. The above *OR* of 1.59 was found on a recent study investigating the association between condom use and HIV infection (Bachanas et al., 2016).

To cover for the contingency missing data, losses, and multiple comparisons, I decided to adjust N using the formula below:-

$$N^1 = \frac{N}{1-q},$$

Where *N* is the number of participants, which are needed at the end of the study with all the data being complete for analysis,

Where *q* is the proportion of attrition or missing data and is generally 10%

Where N^1 is the total number of participants that have to be recruited to achieve that the final sample size (*N*)

N^1 =840/ (1-0.1%) =934

Therefore, the adjusted sample size was 934 (467 cases and 467 controls)

Recruitment Procedures and Data Collection

Recruitment and remuneration. I randomly identified facilities based on the sample frame from the county VCT/HCT facilities in the presence of a Medical Officer (MO) or Nurse in Charge (NiC) at the sub-county top facility. Random sampling and convenient sampling was used where necessary to identify the participants exiting the HTC/VCT facility. During the first contact with post-HTC clients, I created a rapport with the participants before proceeding to the actual questionnaire admission time to reduce the chance of giving socially desirable responses. I used the first contact to acquire a further in-depth comprehension of the participant’s experiences and ascertaining eligibility before the data collection.

I dd a thorough screening of the circumcision status based on the self-reported information provided (Rasmussen et al., 2016). I asked them to indicate when and where the circumcision and their HIV status before circumcision. I did this to exclude the traditional, child, or infant male circumcision cases or HIV positive before circumcision from the eligible cases.

The demographic and behavioral information collected included age, the number of sexual partners, relationship status, circumcision status (screened for when circumcised, the status of HIV before circumcision, type of circumcision), and sexual health (including sexual activeness in the previous one year preceding the study, attitude and belief about VMMC). Participants who consented to participate in the research were given a monetary token of 100 Kenya Shillings (approximately US$ 1) in cash upon completion of the questionnaire. This small token was a form of appreciation for participating in the study, but not high enough to compensate for their time spent, transport, loss of income, or to be deemed as an undue enticement.

Informed consent. I conducted the study following the Helsinki Declaration. I addressed ethical issues before and during recruitment and data collection. Before enrollment in the study, all-volunteer participants were required to assent to informed written consent before participating in the interview. The participant's informed consent agreement was transcribed at a 6^{th} grade English comprehension level (also known as the Fry method) and translated into the local language (Luo). Before consenting, I thoroughly explained to all the participants in a language and style that they were most comfortable about the study interview modes, purpose, rationale, benefits, and potential risks of study participation, including measures that were abided to and considered to ensure participant’s confidentiality. Also, I emphasized and reiterated on the privacy, confidentiality, voluntary nature of participation, and assurance on the anonymity of the sensitive information obtained. I assigned a study number to all participants after obtaining informed consent to safeguard their confidentiality further. All participants received a copy of their informed consent while I kept the other copy. Finally, I reiterated to the participants that their participation was voluntary and that each was unrestricted to pull out from the study process at any stage of the questionnaire administration whenever they desired, devoid of any consequences.

Data collection procedures. In ensuring the participants' confidentiality, all interviews were conducted in a private place, preferably to the respondent. I ensured that the chosen settings were private enough (where no one could overhear the interview process). I reiterated the essence of privacy to both the participant and any of his friends, who might have wanted to listen to the interview. This included providing the participants with the opportunity to select the venue for interviews, but preferably at the health facility where they obtained their HIV test.

The questionnaire did not collect any personal identifying information nor included names. After agreeing to sign the informed consent, I collected the data using a face-to-face interviewer-administered questionnaire to one participant at a time. This interview lasted between 35 and 55 minutes. The questionnaire was administered in English and captured using electronic data capture portable netbooks to reduce data entry time lag. The portable netbooks provided me with a low-cost method for capturing high-quality data that allowed on-screen validations (Ojwang et al., 2014). This data collection method also enhanced data security and the confidentiality of the participants (Galbraith et al., 2014). The questionnaire covered the scope of the study objectives, research questions, and hypotheses entirely.

After administering the questionnaire, I thanked all participants. Those participants, who had any questions or referral needs, were linked with the local facility for further support or counseling. Prior arrangements were made with the facility to attend to any referrals. I also provided additional information materials regarding the study procedures, confidentiality, benefits, and risks for taking home. The information materials also included referral information for HIV testing at the nearest facility, preferable to the participant (Abbott et al., 2013).

Instrumentation and Operationalization of Constructs

Pilot Testing of Instrument

The first step was to combine the adopted instrument with my own into one instrument. The combined instrument was pilot-tested in one site that was not part of the actual data collection process. I conducted pilot testing the instrument in one facility in the neighboring county (Kisumu County Hospital) with similar population characteristics. I conducted a pilot test using a sample of 25 respondents from HTC clients visiting the facility. I received prior approval from the relevant health facility management to do the pilot test. I then administered the pilot test instrument on this limited scale. Then I reviewed the pilot tested instrument and value-addition adjustments based on the pilot test outcome. I looked for patterns in the feedback on the questions where I encountered numerous similar hesitations, requests, and appeals for clarification, propositions for using different wording, etc. I then exploited the pilot data's feedback to revise the instrument before producing the final instrument, which I administered in the last study survey.

Operationalization of Constructs

Belief about VMMC: This variable measured the level of perception about VMMC, partial, and complete protection from HIV infection (Wilson et al., 2014). It tested the participants' subjective belief about the efficacy of VMMC in reducing the chances of HIV infection and whether it can completely annul the likelihood of HIV infection (Kaufman et al., 2017). I asked the participants to state their risk with the following questions: ''Generally, what level of protection do you think the VMMC offers against HIV infection?'' (Westercamp et al., 2014). I scored the responses from "0 = Complete protection 1 = Partial protection; 2 = No protection; and 3 = "don't know."

Unprotected sex: This referred to any sexual act without using a condom or cases whereby condoms are not used consistently during high-risk sex in the previous one year before the study (Chikutsa et al., 2013; Engedashet et al., 2014). I defined high-risk sex as unprotected penile-anal intercourse / penile-vaginal intercourse (PVI/PAI)with any non-spousal/marital or non-cohabiting partner (Chikutsa et al., 2015). Consistent condom use implied to the use of a condom every sexual encounter (100% of all the sexual acts) of every sexual act (Fonner et al., 2014; Zhang et al., 2015) of penile-vaginal or insertive anal sex (Rhodes et al., 2017) with any non-spousal or non-cohabiting partner (FHI 360, 2000). I conducted the screening to include individuals that were sexually active in the previous one year preceding the study (Fonner et al., 2014). Unprotected sex questions were only limited to non-spousal sexual partners (Kong et al., 2012). I prompted the participants with a yes/no question on "whether they have had any PVI/PAI in the last 12 months?" I measured unprotected sex by the type of sexual partner (regular/stable, casual, paid sex, etc.), the number of partners (Fonner et al., 2014). I asked the participants "if they have ever had unprotected sex in the last 12 months," using the above factors (the type of sexual partners, etc.). All the above questions were based on a well-validated timeline follow-back (TLFB) approach (Weinhardt et al., 1998). The TLFB provides the participants with a working calendar to plot all the sexual experiences for a specified period, including memorable dates/events/partners, patterns of sexual encounters (such as weekend meetings with partners) (Weinhardt et al., 1998, p.3), days when they were sexually active, by mapping them in the calendar starting with the most recent. For every sexual partner, participants were asked whether they used a condom at the last sex, number of partners, number of non-marital partners, condom use with all partner relationships (casual, paid sex, etc.) (Oppong Asante et al., 2016). All these activities were recorded on the TLFB calendar.

I used a dichotomously coded (yes/no) measurement scale for unprotected sex questions depending on the intention and response (Fonner et al., 2014). Some analyses were restricted to specific questions attempted by over 85% of the participants to avoid any bias (Forstmeier et al., 2017).

Age: This referred to the contemporary period (in years) the participant has lived since they were born. I asked the participants to state either their year of birth or how old are they? In the data set, I grouped the respondents into four categories (18-24, 25-31, 32-38, above 38 (39-49), due to their relative homogeneity. Participants who did not know their actual age was prompted to state the comparative estimate based on the above four age group categories.

Number of Sexual Partners: This refers to the sum of concurrent non-marital sexual partners in the last year (Weiss et al., 2015). First, I asked the participants to discuss their sexual histories in the previous one year before the study. This included whether they have had sex (yes/no). If yes, ‘‘please indicate with how many different partners have you had consensual PVI and or PAI within the last 12 months?’’. I recorded the count variables from zero up to 16 partners. I reminded the participants to include even one single occasion of sexual intercourse.

Relationship Status: This referred to the partner type during the previous 12 months and included regular/stable, casual/irregular, marital, and nonmarital partners. I described the stable sexual partners in this research as male or female sexual relations that the participant has had a durable sexual bond, especially longer than six months (Zhang et al., 2015). I described a casual sexual partner as male or female sexual relations that the participant had had a temporary sexual bonding (including a single encounter) ((Zhang et al., 2015, p. 817). Founded on the response to the number of sexual partners' question, I prompted the participants to state the partner type of all the partners mentioned. I did this using the following prompt: ‘‘which of the below appropriately illustrates your relationship about sex with diverse types of sexual partners, i.e., partner 1, partner 2, partner 3, . . . partner X.’’ Possible responses included “marital/spouse,” “stable/ serious girlfriend/living together,” “casual/no commitment/one-time sexual encounter,” and “female sex worker/ transactional” sexual partners. Individuals with only one partner in the last 12 months and that partner type is “marital” or “stable” were excluded from the analyses related to condom use and partner type.

Data Analysis Plan

I conducted all analyses using IBM SPSS Statistics v24. The process started by coding the quantitative survey using EDC portable netbooks to reduce data entry time lag. I programmed the EDC with automatic data quality checks (such as skips and disallow outlier responses) in addition to direct real-time transmission of field data to a central server (Ojwang et al., 2014). I then exported the data to SPSS for initial data cleaning and analysis. I then prepared a data cleaning and analysis plan. I summarized this plan in tables guided by the study objectives, research questions, and hypotheses.

I was guided on the data cleaning process by the data analysis plan and began by conducting various descriptive statistics. I conducted the data cleaning process using SPSS. This involved identifying missing data, normality, linearity, outliers, homoscedasticity, and multicollinearity (Hair et al., 2010; Yuan, 2010). I conducted consistency checks to classify the data, which may have had abnormal values (either extreme or out of range) and or those that were logically incongruous. I corrected the identified cases by going back to the original questions. I replaced the missing data using the hot and cold deck imputation method to reduce their adverse effects (Hair et al., 2010). While for the scale items, I used the single-mean imputed value if <15% of the responses were missing on a particular scale. But when >15% were missing, it was not considered in the analysis and was deemed as missing.

Table 3. Summary of Nature of Study Variables, Coding, and Decision on Logistic Regression

Study variable	Nature of variable	Variable values and coding	Decision of the logistic regression based on the nature of the outcome (binary)
Belief about VMMC	Ordinal	Generally, what level of protection do you think the VMMC offers against HIV infection? 0 = Complete protection 1 = Partial protection 2 = No protection 3 = Don't know	Yes
Unprotected sex	Nominal	0 = no 1 = yes For condom use related question:- Ever had unprotected sex (1 = yes, 0 = no) - [Nominal] Did you ever used condom at last sex? (0=no; 1 = yes,) - [Nominal]	Yes
Age	Continuous	Data collected: 18-49 In the data set, I grouped the respondents into four categories 0 = above 38 (39-49) 1 = 18 - 24, 2 = 25 - 31, 3 = 32 - 38,	Yes
Number of sexual partners	Continuous	I recorded count variables for up to 0-16 partners. The exact number was specified.	Yes
Relationship status	Nominal	0 = marital/spouse; 1 = stable/ serious girlfriend/living together; 2 = casual/no commitment/one-time sexual encounter; and 3 = Multiple relations Note: Multiple responses on unprotected sex the number of sexual partners relationship status were recoded as multiple relations	Yes
HIV Status	Nominal	0 = no 1 = yes	

Research Questions and Hypotheses

The research responded to the subsequent research questions and tested the following null and alternative hypotheses.

RQ1: What is the association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

$H_0$1: There is no association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

H_a1: There is an association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ2: What is the association between engaging in unprotected sex and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

$H_0$2: There is no association between engaging in unprotected sex and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

H_a2: There is an association between engaging in unprotected sex and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ3: What is the association between age and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

$H_0$3: There is no association between age and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

H_a3: There is an association between age and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ4: What is the association between number of sexual partners and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

$H_0 4$: There is no association between number of sexual partners and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

$H_a 4$: There is an association between number of sexual partners and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ5: What is the association between relationship status and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

$H_0 5$: There is no association between relationship status and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

$H_a 5$: There is an association between relationship status and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ6: What is the association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya, controlling for engaging in unprotected sex, age, number of sexual partners, and relationship status?

$H_0 6$: There is no association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya, controlling for unprotected sex, age, number of sexual partners, and relationship status.

H_a6: There is an association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya, controlling for unprotected sex, age, number of sexual partners, and relationship status.

Descriptive statistics were employed to explain the summary of demographic traits and risk factors of HIV infection of the participants in both groups (HIV positive and HIV negative). I used the interquartile range to express the median values. I assessed the population prevalence and differences among the groups using a *t-test* for continuous variables and Pearson's chi-square statistics ($\chi 2$) for categorical variables. At the same time, *Wilcoxon's Two-Sample Test* was used to test interval variables with abnormal distribution to examine the relationship between the main independent variables of belief about VMMC and the other independent and controlling variables using the 95% confidence interval (CI). In cases where there was any difference >10% in the incidence ratios of VMMC perception, an interaction term was introduced. Then I proposed an interaction term between unprotected sex, age, number of sexual partners, and relationship status in the mixed regression models for every unprotected sex to additionally examine if these independent tests were significant.

I further investigated the effect of belief about VMMC on HIV status. I applied bivariate logistic regression devoid of adjusting for the effect of independent variables in model 1, after adjusting or controlling for the effects of age, relationship status, and the number of sexual partners in model 2 to identify factors associated with HIV status. This was followed by stepwise binary logistic regression analysis to account for any unique variance above what was accounted in model 1. This was conducted separately with regular or marital sexual relationships and with multiple, paid, and casual or non-marital sexual relationships (in the expanded regression models) (Zhang et al., 2015). Standardized beta values (B), $R^{2,}$ and the DR^2 were accounted for in the model.

The results are reported as odds ratios, adjusted odds ratios, confidence interval (CI), and corresponding p-values to identify variables independently associated with outcome variable for all the predictors in all the regression models. Only variables with a statistically significant association of p-value < 0.1 in bivariate analyses were considered for the final multivariate model. In the final model, the backward elimination method was used for those that did not remain significant (<0.05), except for age and independent variables (belief about VMMC and unprotected sex) were retained irrespective of the statistical significance level, up to when the final model was decided (Engedashet et al., 2014; Galbraith et al., 2014). Nagelkerke R^2 provided an estimation of variance explained (McKay et al., 2017). I tested any interactions within each hierarchal model (Vandenhoudt et al., 2013). I utilized the crude *OR* and *p*-value to approximate the strength of the association between independent variables and HIV status. All the analysis was adjusted and weighted for non-randomized characteristics and the likelihood of nonresponse. I conducted additional analysis to measure inter-item correlation and factor analysis. This included adjusting for the effects of potential confounding variables at all stratified cluster levels. I restricted all analyses related to unprotected sex to sexually active participants in the last one year.

I used discriminant function analysis (DFA) to determine which combination of the independent variables and controlling variables that best predicted the HIV status. I used *Huber–White* standard errors to estimate and adjustments made for clustering at the facility level, where participants' sampling was done. I measured change in *-2Log* (likelihood) statistics to test any interaction effects by contrasting models with main effect variables and their interaction terms.

Threats to Validity

External validity. The screening for participants that met the study inclusion criteria before sampling could reduce the likelihood of incomplete random sampling, which consequently could pose a threat to external validity (Moons et al., 2012). Secondly, the refusal to participate could bias the final results (Frankfort-Nachmias et al., 2015). Thirdly, the unexpected and confounding factors could also be a threat to external validity. Lastly, further threats to external validity that may arise could include statistical conclusion validity and construct validity (Creswell, 2009).

I used the following strategies to increase the generalizability of the results across the circumcised male population in Homa Bay County, Kenya. A random sampling of the selected facilities and incidence density sampling of participants recruited (if adequate numbers were available) across all the eight sub-counties. I did this to give a full representation of the whole country. Using incidence density sampling design in recruiting the participants could have reduced the self-selection bias. Besides, calculating the appropriate sample size and matching the participants by age and relationship status from all geographic areas (sub-counties) could also reduce threats to external validity.

Furthermore, adopting a consistent standard process in identifying the two groups (HIV positive after VMMC and HIV negative after VMMC) may also have had a reduced threat to external validity (Bandera et al., 2013). The inclusion criteria were based on empirical gold standard criteria in identifying the HIV status. The use of different groups (such as HIV positive and HIV negative; age groups; different relationship status) could also have decreased the threats owing to unforeseen and confounding factors (Frankfort-Nachmias et al., 2015).

Internal validity. I utilized the Campbell & Stanley's (1963) threats to internal validity as appropriate to assess the study's internal validity. This study's results comprised self-reported information, which might be a peril to the study's internal validity. Although there is a likelihood that social desirability bias could have aroused, whereby participant's answers may have been influenced by what is socially acceptable either due to stigma or observer bias. The possible threats to internal validity could also include the validity of a questionnaire and the measures for perceptions on specific constructs to ensure consistency with other previous specialist opinions and research questions.

I attempted to maintain the internal validity of the study by using different strategies. First, the self-reported approach to data collection is the most appropriate method of investigating sexual behaviors (DiClemente et al., 2013). The study utilized self-reports to measure the participants' opinions, concerns, beliefs, and feelings towards beliefs about VMMC and unprotected sex. Secondly, I provided a conceptual definition of the constructs used in the study, such as crucial variables that were used to demonstrate an association with the outcome. I also translated the conceptual definition into an operational definition for the study. I exclusively collected data to guarantee a standardized comprehension and administration of data collection instruments (Emmanuel et al., 2015), thereby reducing threats to internal validity.

The study instruments were pre-tested and piloted in one of the sites not included in the study. The pre-test ensured that the instrument's accuracy or reliability in generating vital information was ascertained before the actual use. I also ensured that relevant validity checks of self-reported data were put in place equally within and across multiple investigations to enhance the quality of data collected. This provided accurate reporting during data collection and analysis (DiClemente et al., 2013). Other strategies were employed to enhance the validity of self-reported sexual behavioral data both within and across the study measurements (Kelly et al., 2013). Finally, during the analysis, I used binary logistic regressions to ascertain the effect of the study variables while statistically controlling for any confounding variables.

Ethical Procedures

Before proceeding with any data collection, I pursued ethical clearance from the Walden University Institutional Review Board (IRB) and Kenyan National Commission for Science, Technology, and Innovation (NACOSTI), a local Ethics Review Committee (ERC), to conduct the study after reviewing the research protocol. The approval ensured that the study is in line with the Helsinki Declaration (on the protection of human subjects) and that the research was not unethical, and none of the participants was taken through any psychological or physical risk (approval 02-14-19-0561444). The above institutions reviewed any subsequent modifications to the study protocol, informed consent, and data collection instruments. I pursued further cooperation and permission to conduct the study with the Homa Bay County Ministry of Health (MoH).

Integrity, confidentiality, and objectivity are the foundation of any research (National Academy Press, 2009). Therefore, obtaining IRB approval ensured that the research protocol was rigorous and that all the participants were protected from any form of exploitation. Exploitation could include the use of personal identifying information and usage of collected data for unintended purposes extraneous to the study objectives. I ensured that I removed all identifying information for all research participants to uphold the anonymity, confidentiality, and protection of the participants' privacy. I recorded no personal identifiers in the respondent questionnaires. Participants’ privacy and confidentiality was my priority. I ensured that all data and participant information remained strictly confidential, and access to master logs will be limited.

Summary

The chapter presented the quantitative methodology and how the case-control method was employed. The study investigated whether there are any differences between HIV positive and HIV negative circumcised males aged between 18-49 years regarding their beliefs associated with the false protection of circumcision and related unprotected sexual activities in Homa Bay County, Kenya. I explained the study population to include circumcised males aged 18-49 years old recruited from 19 VCT/ HTC facilities randomly selected from eight sub-counties in Homa Bay County, Kenya. In this section, I have described how I applied the incidence density sampling design in the study. I have presented the criteria used in creating the sampling frame and procedures in the chapter. I have also illustrated how the sample size calculation was determined using EPI INFO 7.10. I have explained how I depicted the sample size of 936 participants.

The section also presents how the participants were recruited and remunerated. It has also explained how the informed consent and other ethical issues were addressed and elaborated on the data collection procedures. I have also highlighted all the study procedures and how I dealt with confidentiality, benefits, and risks. The chapter also explains how I ensured the privacy of participants. I explained how I used the portable netbooks to reduce data entry time lag, enhanced data security, and participants' confidentiality. The chapter also describes how the instrument was adapted and used to collect the data. I explained the choice of the instrument, reliability, as demonstrated in previous studies. The further illustration was provided on the link between the instrument and the measure of HBM constructs and self-protection behaviors.

The chapter has also expressed how I developed the analysis plan and conducted the data cleaning. This included conducting various descriptive statistics, consistency checks, and using the imputation method to handle the missing data. The chapter also depicts how the internal consistency was measured, including how the scales and instruments' internal reliability was tested. Further illustration of how the descriptive statistics, t-test, Pearson’s chi-square statistics ($\chi 2$), and Wilcoxon’s Two Sample Z Test were applied to examine any relationship between them the dependent variable. A detailed description of how the Partial Pearson correlation coefficients, bivariate logistic regression, and hierarchical multivariate logistic regression analysis was explained. The chapter also presents how the results will be reported using odds ratios (*OR*) and explained how the interaction effects were measured. I also described how the DFA was performed to identify which combination of variables I that best predict the HIV positive status.

The further illustration was provided on how possible threats to validity were addressed and how the site selection was made to represent the whole county. Description of how the pre-testing and piloting of the study instruments were explained, including how relevant validity checks to ensure high-quality data collection were conducted. Finally, the chapter describes how the appropriate ethical clearance and approval were obtained before effecting the study to ensure the protection and privacy of the participants, integrity, confidentiality, and objectivity of the research. In the next chapter, I will describe the study results.

Chapter 4: Results

Introduction

The purpose of this study was to investigate whether there are any differences between belief about VMMC, unprotected sex, age, number of sexual partners, relationship status, and HIV status among circumcised males aged between 18-49 years in Homa Bay County, Kenya. The behavioral disinhibition may occur in VMMC and other prevention and risk reduction interventions due to the perceived complacency vis-à-vis the actual protection from the intervention in preventing HIV infections (Agot et al., 2007; Underhill, 2013). This perceived false protection might expose males to risky sexual behaviors (Westercamp et al., 2014). Therefore, calculating the odds ratio to measure the association between belief about VMMC and other covariates and HIV infection could provide more insights into risk factors and consequent implications for clinical outcomes on circumcised males in Homa Bay County, Kenya. This could provide a significant first step towards designing, implementing, and assessing sustainable future public health initiatives to avert HIV infection. To determine the association bewteen beliefs associated with the false protection of circumcision (Msango & King, 2019; Westercamp et al., 2014), unprotected sex, age, number of sexual partners, relationship status, and HIV status, I structured the following research questions to be answered by this study:

RQ1: What is the association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

$H_0$1: There is no association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

H_a1: There is an association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ2: What is the association between engaging in unprotected sex and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

$H_0$2: There is no association between engaging in unprotected sex and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

H_a2: There is an association between engaging in unprotected sex and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ3: What is the association between age and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

$H_0$3: There is no association between age and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

H_a3: There is an association between age and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ4: What is the association between number of sexual partners and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

$H_0$4: There is no association between number of sexual partners and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

H_a4: There is an association between number of sexual partners and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ5: What is the association between relationship status and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

$H_0$5: There is no association between relationship status and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

H_a5: There is an association between relationship status and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ6: What is the association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya, controlling for engaging in unprotected sex, age, number of sexual partners, and relationship status?

$H_0$6: There is no association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya, controlling for unprotected sex, age, number of sexual partners, and relationship status.

H_a6: There is an association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya, controlling for unprotected sex, age, number of sexual partners, and relationship status.

This chapter presents findings on the HIV status outcomes of 936 circumcised males aged between 18-49 years. All the participants were recruited based on their HIV status, including (a) 468 HIV positive (cases), and (b) 468 HIV negative (controls) from 19 HTC/VCT facilities in all the eight sub-counties of Homa Bay County, Kenya. This chapter explains the data collection procedures, describes how the data was analyzed, and highlights the summary of the results.

Pilot Study

First, the face validity of the questionnaire was confirmed by various experts, including my chair and committee member. The questionnaire was then pilot tested among 25 participants exiting the Kisumu District Hospital HTC facility. The overall reliability of the instrument measured using Cronbach's alpha was α = .71 on 25 items. This disclosed skewness values (at least less than 3) and kurtosis (at least less than 6), which implied that my data was normally distributed. The Cronbach's Alpha for questions demonstrating the sexual histories was α = 0.84, signifying high internal consistency in the responses. These findings denoted the satisfactory level of the construct validity and internal consistency (Taber, 2018) of the adapted instrument used. Therefore, the instrument was appropriate to measure the circumcised males' conceptions, sexual behaviors, and HIV status.

Data Collection

The data collection took me about two months (62 days) to complete the planned sample size. This started on April 1, 2019, and ended on June 7, 2019. There was no discrepancy between the planned data collection, as presented in chapter 3, and the actual data collection. I divided the Homa Bay County, Kenya, population into eight administrative clusters (sub-counties). I then stratified and sampled 19 HTC/ VCT facilities, at least one site each in the lower level (Level 2 = medical clinics; Level 3 = health centers) and higher level (Level 4 = full hospitals; Level 5= county referral hospitals), according to the MOH classification of health facilities.

All males aged between 18-49 years presenting for the HIV testing program in the sampled sites were notified about the study and screened for eligibility. I used an interviewer guide to administer the questionnaire that covered the study's scope, research questions, and hypotheses entirely. I deliberately applied incidence density sampling to match the recruited participants based on the same time when the cases were identified or occurred. Each time a case was identified, one control was selected randomly (if there were many) or else conveniently from the members of the base population. The recruitment continued until I attained the required sample size.

I examined retrospectively unprotected sex and other covariates (circumcision status, belief about VMMC, HIV test results, age, number of sexual partners, and relationship status) during the last 12 months preceding the survey and characterized them by HIV status. I administered the questionnaires in English and captured it using EDC portable netbooks to reduce data entry time lag. This included interviewing and collecting the data from the sampled clients exiting 19 HTC/VCT facilities in Homa Bay County, Kenya.

Demographic Characteristics

A total of 936 respondents were recruited. The age groups ranged between 8 - 24 years (*n* = 276), 25-31 years (*n* = 313), 32-38 years (*n* = 201), and 39-49 years (*n* = 146 (see Figure 3). Other demographic details are presented in Figures 3, 4 and Table 4.

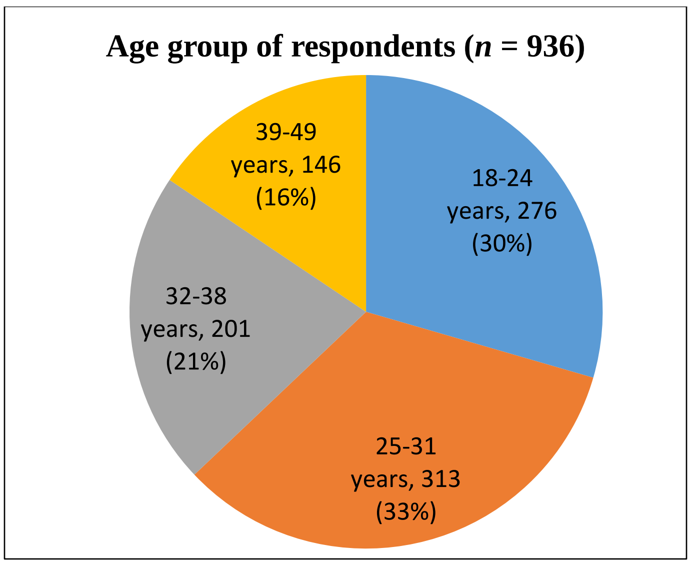


Figure 3. Demographic characteristics by the age group.

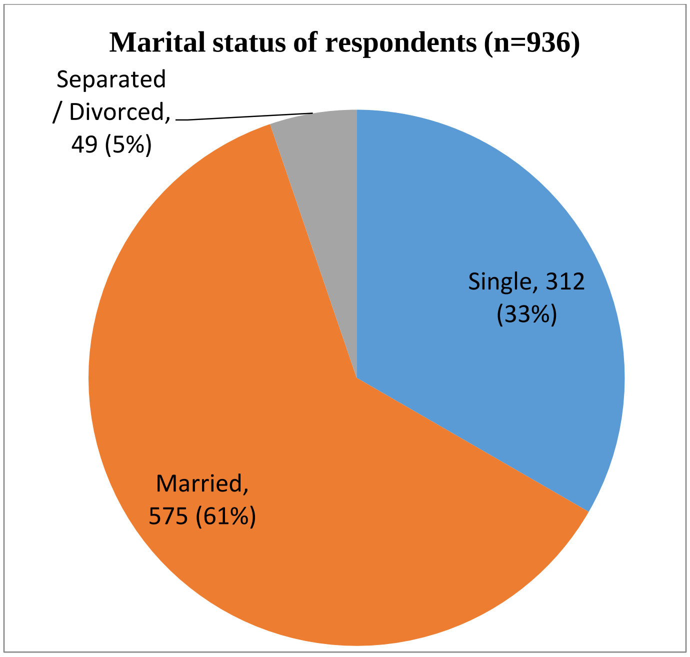


Figure 4. Demographic characteristics by marital status.

Demographics characteristics by marital status included single (*n* = 312), married (*n* = 575), separated /divorced (*n* = 49; see Figure 4).

Representativeness of the Sample

I calculated the sample size based on certain grounded principles: confidence level (95% two-sided confidence level to increase the rejection region), statistical power 90% (to detect a real association between unprotected sex and HIV status), the ratio of control to cases of 1, percentage of exposure among the control (*p*) 52% (in this study, the prevalence of unprotected sex; KNBS & ICF Macro, 2014), and odds ratio of 1.59 based on the previous research (Bachanas et al., 2016). The statistical calculator generated 840 participants, 420 cases, and 420 controls (Fleiss with continuity correction factor [w/CC]; Kelsey, Whittemore, Evans, & Thompson, 1987). At a prevalence (*p*) of

52%, Schlesselman and Stolley's formula provides the most significant sample size achievable due to the maximum variance, *p*(1_p), thereby boosting the power of the study and decreasing the possibilities of type II error (McCambridge et al., 2014). The above *OR* of 1.59 was found in various recent studies investigating the association between condom use and HIV infection (Bachanas et al., 2016). To cover the contingency missing data, losses, and multiple comparisons, I adjusted the sample size to 936 (468 cases and 468 controls).

The above sample size did not undermine the external validity. The final characteristics of the participants selected through the incidence density sampling reflected that of the target population. First, the inclusion and exclusion criterion revealed the sample included and excluded. Secondly, I conducted observations in conditions that reflected the actual real-life behavior. I tried to reduce the Hawthorne effect (McCambridge et al., 2014), as I explained to the respondents that this study was not closely monitoring their behavior. Finally, the sample size of 936 reflected the entire targeted population and took into consideration possible sampling errors.

Univariate Analysis

HIV status. HIV status was coded no/yes (0/1). Half of the respondents (50%) were HIV positive (n = 468), and the other half were HIV negative (n = 468). See Figure 5 below.

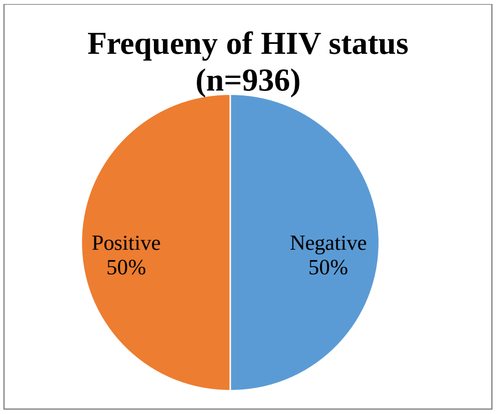


Figure 5. Descriptive analysis of participants by HIV status.

Belief about VMMC. The distributions of participants by their belief about VMMC were as follows: - No protection (*n* = 108), Partial protection (*n* = 675), Complete protection (*n* = 97), and don't know (*n* = 56; see Figure 6). The median and the mode was partial protection belief about VMMC. When the median and mode are the same, it indicates a perfectly symmetrical distribution. This further signified the unimodal distribution of the data. The skewness of the distribution was 3.715 with a Std. Error of Skewness =.080. Skewness < -1 or > 1 indicated that my data was highly skewed.

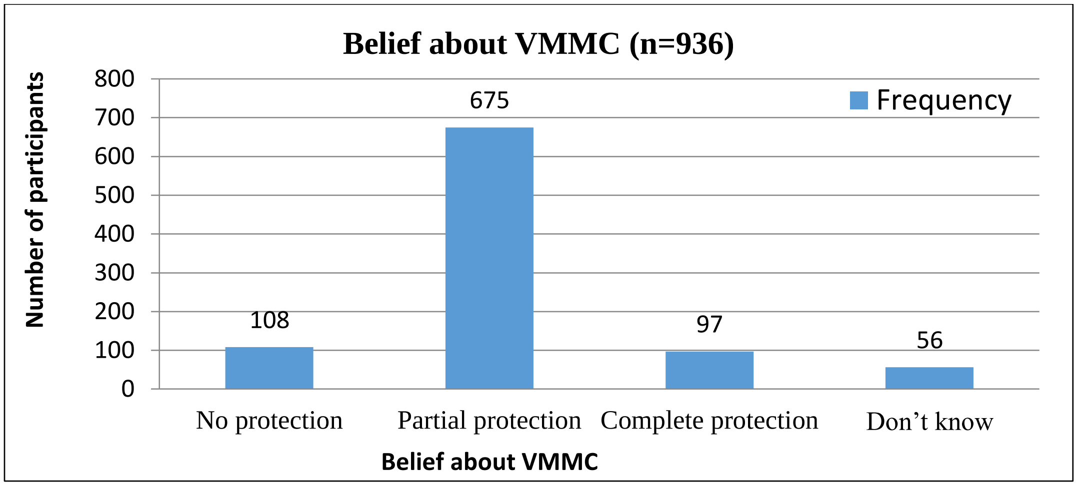


Figure 6. Distribution of participants by belief about VMMC.

Unprotected sex. The unprotected sex was coded no/yes (0/1). Analysis of Unprotected sex was considered only for non-marital sexual partners. About 49.8% (*n* = 352) had unprotected sex in the last 12 months while 50.2% (*n* = 355) had protected sex (see Figure 7 below).

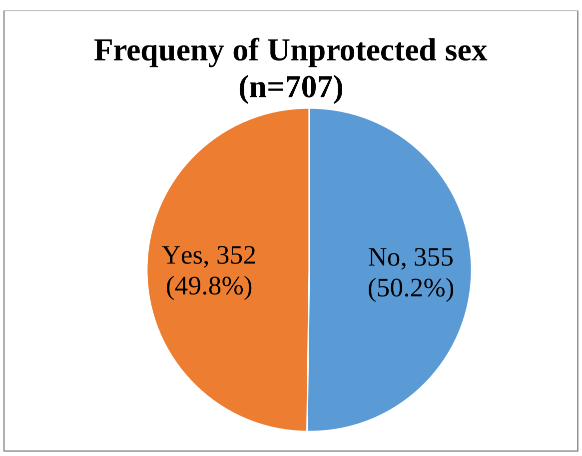


Figure 7. Descriptive analysis of participants by unprotected sex.

Age. In this section, I present the univariate analysis of the age variable. The participants' ages ranged from 18 to 49 years, with a mean age of 29.59 [±7.79], a median of 29 years, and a mode of 30 years. The standard deviation of ±7.79 indicates that the sample had a medium variability. Therefore the hypothesis test can yield a more specific estimate of the population effect (Cardina, 2015). The Age had a right-skewed distribution of .408 (with the median being less than the mean), indicating that the data was fairly symmetrical. Figure 8 shows that the dataset was multimodal (more than two peaks). There was only one outlier with data having a normal distribution with observations aligned approximately on a straight line (See Figure 9). The data for age meets the basic assumptions for a covariate in logistic regression. There was linearity in the logit for the age variable, the independence of errors, and the absence of strong significant outliers, as indicated in Figures 8 and 9.

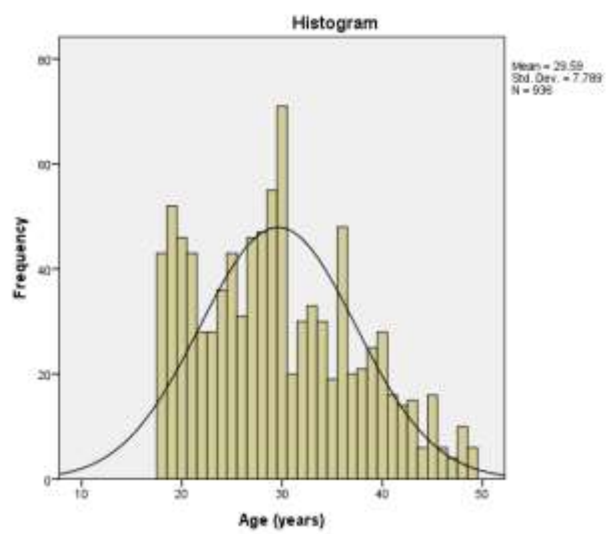


Figure 8. Histogram distribution of the age (years).

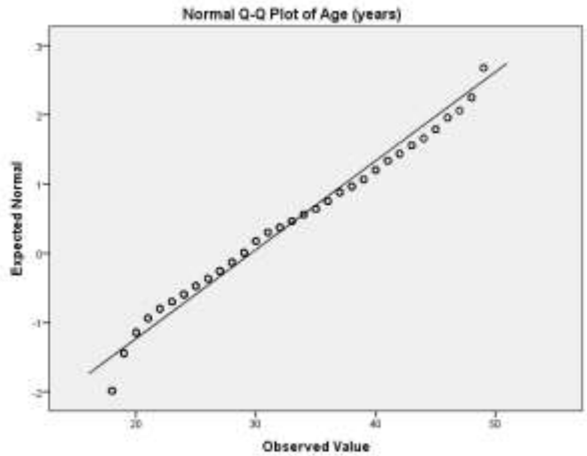


Figure 9. Normal Q-Q plot of age (years).

Number of sexual partners. The Number of sexual partners ranged from 0 to 16 partners, with a mean of 1.48 [±1.55], a median of 1 partner, and a mode of 1 partner. The standard deviation of ±1.55 indicated that the sample had low variability. Therefore the accuracy of the hypothesis test could have revealed small effects (Cardina, 2015). The number of sexual partners had a right-skewed distribution of 2.765 (with the median being less than the mean), indicating that the data was highly skewed. Figure 10 below showed a unimodal dataset (one clear peak) signified that most of the universal values represented by the histogram. There were also strong outliers towards the right with data having a heavy-tailed distribution (See Figure 11). The data for the Number of sexual partners' variables met the basic assumptions for an independent variable in logistic regression. I used Turkey's three-point method using the Q-Q plots to re-state the variable to make it approximately normal using the square root to linearize it (Bland & Altman, 1995). There was linearity in the logit for the number of sexual partners' variable, the independence of errors, and the presence of strong significant outliers, as indicated in Figures 10 and 11. The outliers did not affect assumptions and results in my logistic regression. Therefore, it was not reasonable to drop them. However, I ran both analyses with and without the outliers and indicated any changes in the results.

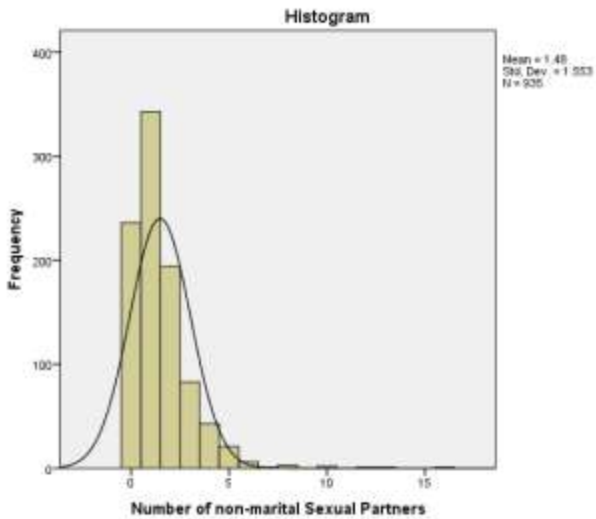


Figure 10. Histogram distribution of the number of sexual partners.

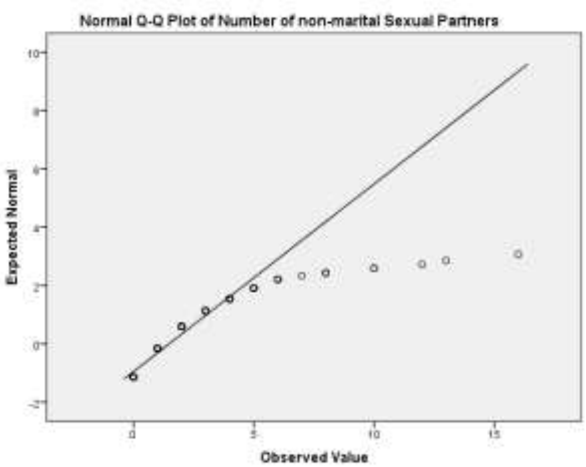


Figure 11. Normal Q-Q plot of the number of sexual partners.

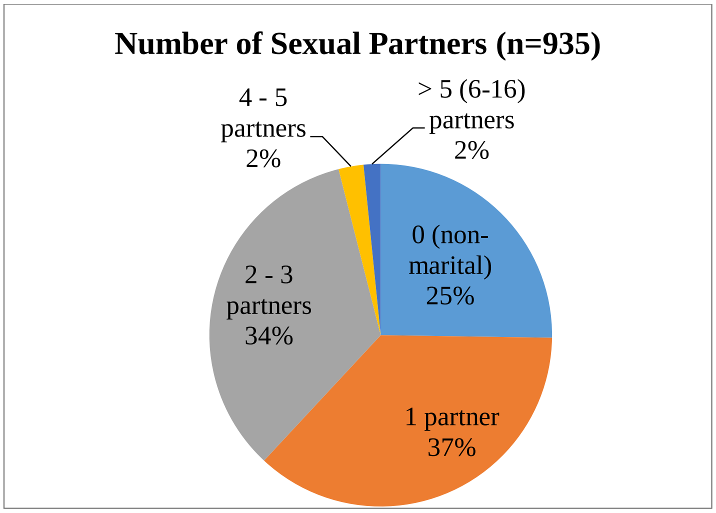


Figure 12. Distribution of participants by the number of sexual partners.

Relationship status. The distribution of the participants by relationship status was as follows:-Marital 25% (n = 228), Stable 18% (n = 170), Casual 10% (n = 94), and Multiple relations 47% (n = 443; see Figure 12).

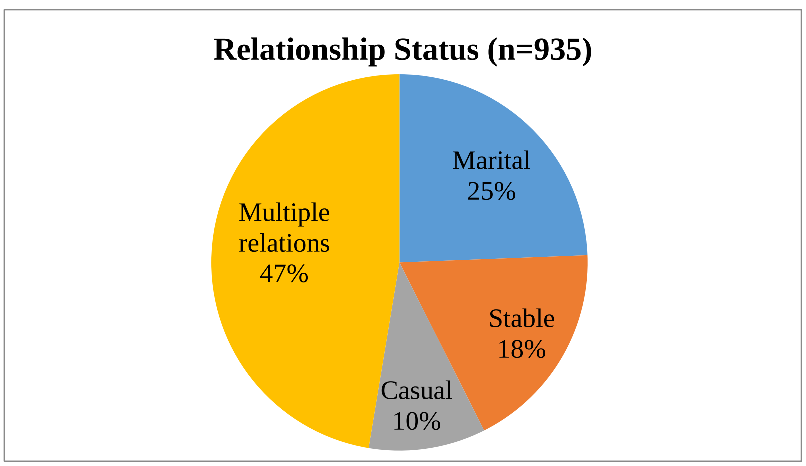


Figure 13. Distribution of participants by sexual relationship status.

Results

Statistical Analysis

I analyzed the data using IBM SPSS Version 24. I was guided in the data cleaning and analysis plan by the study objectives, research questions, and hypotheses. The data cleaning process began by conducting various descriptive statistics. This involved identifying missing data, normality, linearity, outliers, homoscedasticity, and multicollinearity. I replaced the missing data using the hot and cold deck imputation method to reduce their adverse effects (Andridge & Little, 2010). In hot deck imputation, each non-response or missing value/data was substituted with observed comparable answers from another unit in the same data set to generate an aggregate data that can be examined with usual analysis methods.

I employed descriptive statistics to explain the summary of demographic traits and risk factors of HIV infection of the participants in both groups (HIV positive and HIV negative). I used the interquartile range (IQR) to express the median values. I assessed the population prevalence and differences among the groups using a *t-test* for continuous variables and *Pearson's chi-square statistics (χ2)* for categorical variables. Simultaneously, I used *Wilcoxon's Two-Sample Test* to test interval variables with abnormal distribution to examine the association between the main independent variables and controlling variables using the 95% confidence interval (*CI*). In cases where there was any difference >10% in the incidence ratios of VMMC perception, I used, an interaction term. I proposed an interaction term between unprotected sex, age, number of sexual partners, and relationship status in the mixed regression models for every unprotected sex act (coded 0/1 for no/yes) to additionally examine if these independent tests are significant.

The effect of unprotected sex, grounded by the HBM on HIV status, was further investigated by applying bivariate logistic regression with each independent variable, as reflected in the research questions. The most parsimonious model predicted the best model after adjusting or controlling for the effects of age, relationship status, and number of sexual partners using Stepwise backward elimination binary logistic regression analysis, to account for any unique variance above what was accounted for in model 1. This was conducted separately with regular or marital sexual relationships (for the 1st and 2nd models) and with multiple, paid, and casual or non-marital sexual relationships (in the 3rd and 4th models). Standardized beta values (B), R^2, and the DR^2 were accounted for in the model. The results are reported as odds ratios, adjusted odds ratios, confidence interval (CI), and corresponding p-values to identify variables independently associated with HIV status for all the predictors in all the regression models.

Discriminant Function Analysis (DFA) was used to determine which combination of the independent variables and controlling variables that best predict the HIV status. I used *Huber–White* standard errors to estimate and made adjustments for clustering at the facility level, where participants' sampling was done. I measured change in *-2Log* (likelihood) statistics to test any interaction effects by contrasting models with main effect variables and their interaction terms.

Table 4.

Participant Demographics

Participant demographics	HIV status							Unprotected sex						
	Total *N*		Negative		Positive			Total *N*		No		Yes		
	N	%	*N*	%	*N*	%	*p*-value	*N*	%	*N*	%	*N*	%	*p*-value
Sub-county														
Kabondo	116	12.4	58	50.0	58	50.0	1.000	89	12.6	39	43.8	50	56.2	<0.001
Kasipul	154	16.5	77	50.0	77	50.0		103	14.6	48	46.6	55	53.4	
Karachuonyo	70	7.5	35	50.0	35	50.0		46	6.5	36	78.3	10	21.7	
Homa Bay Town	134	14.3	67	50.0	67	50.0		102	14.4	55	53.9	47	46.1	
Ndhiwa	84	9	42	50.0	42	50.0		70	9.9	24	34.3	46	65.7	
Rangwe	146	15.6	73	50.0	73	50.0		106	15	47	44.3	59	55.7	
Mbita	156	16.7	78	50.0	78	50.0		122	17.3	49	40.2	73	59.8	
Mbita	76	8.1	38	50.0	38	50.0		69	9.8	57	82.6	12	17.4	
Total	**936**	**100**	**468**	**50.0**	**468**	**50.0**		**707**	**100**	**355**	**50.2**	**352**	**49.8**	
HIV positive														
Negative	468	50						340	48.1	207	60.9	133	39.1	< 0.001
Positive	468	50						367	51.9	148	40.3	219	59.7	
Total	**936**	**100**						**707**	**100**	**355**	**50.2**	**352**	**49.8**	
Age group														
18-24	276	29.5	184	66.7	92	33.3	<0.001	242	34.2	124	51.2	118	48.8	0.905
25-31	313	33.4	142	45.4	171	54.6		221	31.3	110	49.8	111	50.2	
32-38	201	21.5	85	42.3	116	57.7		143	20.2	73	51	70	49	
39-49	146	15.6	57	39	89	61		101	14.3	48	47.5	53	52.5	
Total	**936**	**100**	**468**	**50**	**468**	**50**		**707**	**100**	**355**	**50.2**	**352**	**49.8**	

Participant demographics	HIV status							Unprotected sex						
	Total *N*		Negative		Positive			Total *N*		No		Yes		
	N	%	*N*	%	*N*	%	*p*-value	*N*	%	*N*	%	*N*	%	*p*-value
Marital status														
Single	312	33.3	196	62.8	116	37.2	<0.001	289	40.9	139	48.1	150	51.9	<0.001
Married	575	61.4	260	45.2	315	54.8		370	52.3	209	56.5	161	43.5	
Separated/divorced	49	5.2	12	24.5	32	65.3		48	6.8	41	85.4	7	14.6	
Total	**936**	**100**	**468**	**50.0**	**468**	**50.0**		**707**	**100**	**355**	**50.2**	**352**	**49.8**	
Belief about VMMC														
No protection	108	11.5	45	41.7	63	58.3	0.066	74	10.5	45	60.8	29	39.2	0.011
Partial protection	675	72.1	334	49.5	341	50.5		526	74.4	245	46.6	281	53.4	
Complete protection	97	10.4	57	58.8	40	41.2		64	9.1	40	62.5	24	37.5	
Don't know	56	6	32	57.1	24	42.9		43	6.1	25	58.1	18	41.9	
Total	**936**	**100**	**468**	**50.0**	**468**	**50.0**		**707**	**100**	**355**	**50.2**	**352**	**49.8**	
Number of non-marital sexual partners														
0 (non-marital)	236	25.2	135	57.2	101	42.8	0.057	41	6	21	51.2	20	48.8	<0.001
1 partner	343	36.7	180	52.5	163	47.5		318	45	187	58.8	131	41.2	
2 - 3 partners	319	34.1	136	42.6	183	57.4		312	44	134	42.9	178	57.1	
4 - 5 partners	22	2.4	9	40.9	13	59.1		22	3	5	22.7	17	77.3	
> 5 (6-16) partners	15	1.6	8	53.3	7	46.7		14	2	8	57.1	6	42.9	
Total	**935**	**100**	**468**	**50.1**	**467**	**49.9**		**707**	**100**	**355**	**50.2**	**352**	**49.8**	
Relationship status														
Marital	228	24.4	128	56	100	44	<0.001							
Stable	170	18.2	107	63	63	37		170	24	68	40	102	60	<0.001
Casual	94	10.1	56	60	38	40		94	13.3	51	54.3	43	45.7	
Multiple relations	443	47.4	177	40	266	60		443	62.7	236	53.3	207	46.7	
Total	**935**	**100**	**468**	**50.1**	**467**	**49.9**		**707**	**100**	**355**	**50.2**	**352**	**49.8**	

Note. Due to rounding error, percentages may not add up to 100.

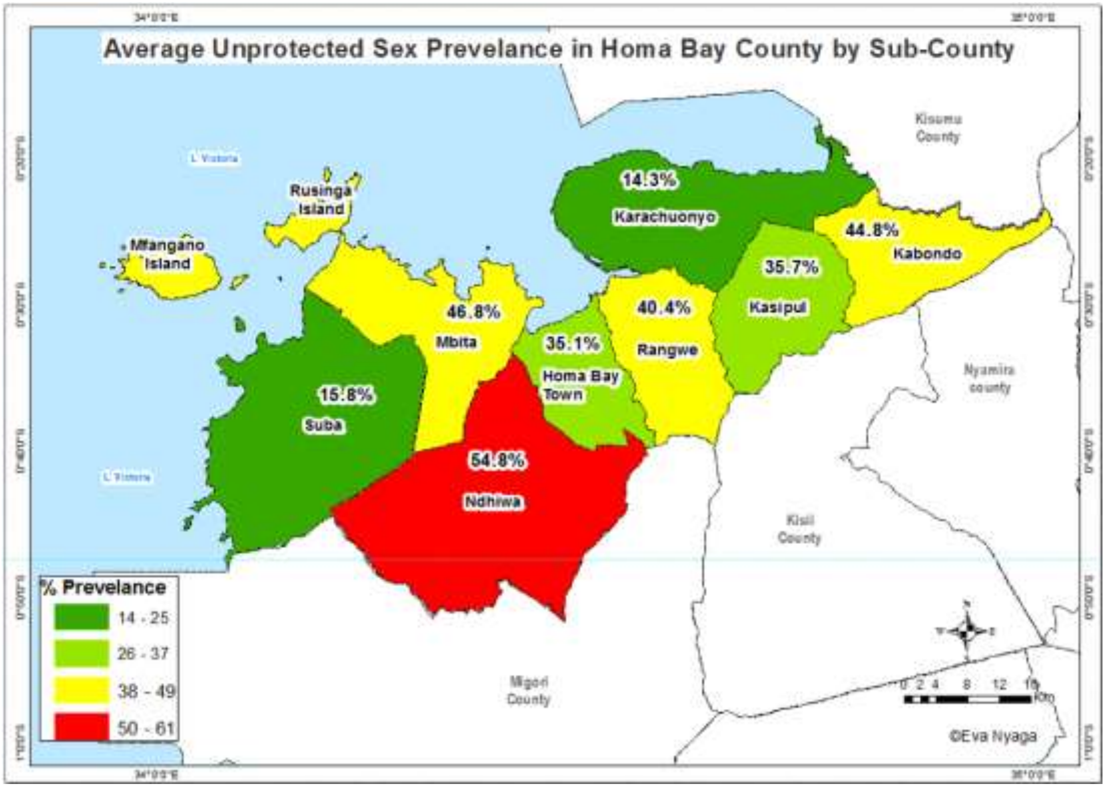


Figure 14. Unprotected sex prevalence in Homa Bay County, Kenya.

Statistical Analysis Findings

Research Question 1

Association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya. The association between belief about VMMC and HIV status was further investigated by applying bivariate logistic regression. The sample included 936 males aged 18-49 years. Out of these, 11.5% believed that VMMC provided no protection, 72.1% believed that VMMC provided partial protection, 10.4% believed that it provided complete protection, while 6.0% didn't know the protection level VMMC provided. I analyzed the data for both groups (cases and controls). Standardized beta values (B), Pseudo R^2, and the DR^2 were accounted for in the model. The results are reported as odds ratios, confidence interval (CI), and corresponding p-values to identify if belief about VMMC was independently associated with HIV status.

Table 5.

Outline of Logistic Regression Analysis for Belief About Voluntary Medical Male Circumcision and HIV Status

Variable	B (SE)	Exp(B)	95% CI
Belief about VMMC [0=Complete protection]			
Belief about VMMC(1) [1=Partial protection]	0.624 (0.333)	1.867*	(0.972, 3.587)
Belief about VMMC(2) [2= No protection]	0.308 (0.281)	1.361*	(0.785, 2.36)
Belief about VMMC(3) [3=Don't know]	-0.066 (0.340)	0.936*	(0.481, 1.821)
Constant	-0.288 (0.270)	0.75*	

Note: R^2 *= .011 (Cox and Snell), .008 (Nagelkerke). Model* $\chi^2(3) = 1290.135$*,* $p > .05$*.*
$^*p > .05$, $^{**}p < .05$

There was a negative association between "partial protection" belief about VMMC and HIV status (See Table 5 above). Based on the negative beta value, the relationship is the reverse. Meaning, a one (1) unit positive change from "Partial protection" belief about VMMC, holding other predictors in the model constant, will result in a decrease in the likelihood of HIV positive event. Because all the categorical predictor variables were not significant, therefore, the coefficients were not significantly different from zero (0). Looking at the Chi-Square goodness of fit test, the overall model was statistically not significant (chi-square of 7.228, p >.005); therefore, I failed to reject the null hypothesis. The *Hosmer-Lemeshow test* (HL test), p>0.05, indicating that the model was a good fit for my data (however, this does not mean the model fits well). The Pseudo R^2 =.010 (R^2, was small, indicating a poor regression model does not fit well my observations). DR^2 *(-2 log-likelihood*) was high, signifying that the model was good but not great. I concluded that the overall fit was relatively weak.

Table 6.

Association Between Belief About Voluntary Medical Male Circumcision and HIV Status

Variable	Odds ratio (95% CI)	*p*-value
Belief about VMMC	1.533 (0.933, 2.133)	p = 0.068

The belief about VMMC yielded an *OR* = 1.533, 95% CI [0.933, 2.133], p = 0.068. From the calculation of the *OR* from the above table, it appears that HIV status is not significantly predicted by Belief about VMMC (see Table 6). Therefore, I failed to reject the null hypothesis (due to the *p*-value being greater than my significance level). I conclude that there is no association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya. Thus, the differences between my study sample population might have occurred by chance. Failure to reject the null hypothesis signified that my study sample did not offer adequate evidence to deduce that the effect occurred.

Research Question 2

Association between engaging in unprotected sex and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya. I conducted the analysis to examine if there was any association between engaging in unprotected sex and HIV status. I used the same sample of 936 males aged 18-49 years in Homa Bay County, Kenya. Out of these, 49.8% reported having engaged in unprotected sex, while 52.2% did not. The study applied bivariate logistic regression to analyze the data for both groups (cases and controls). Standardized beta values (B), $R^{2,}$ and the DR^2 were accounted for in the model. I reported the results as odds ratios, confidence interval (CI), and corresponding *p*-values to identify if engaging in unprotected sex was independently associated with HIV status.

Table 7.

Outline Logistic Regression Analysis for Unprotected Sex and HIV Status

Variable	B (SE)	Exp(B)	95% CI
Unprotected sex (1) [0 = no, 1 = yes]	-.834 (.154)	.434***	(0.321, 0.587)
Constant	.499 (.110)	1.647***	

Note: R^2 =.036 (Cox and Snell), .047 (Nagelkerke). Model $\chi^2(1)$ = 1263.714, *p > .05. **p < .05, ***p < .001

The Exp(*B*) and the direction of the beta values inform us that unprotected sex association with the dependent variable was negative (See Table 7 above). Based on the negative beta values for unprotected sex, the relationship was reverse. Meaning, those who had protected sex were 1.647 times less likely of being HIV positive compared to those who had unprotected sex while holding other predictors in the model constant.

Because the predictor variable was significant, therefore, the coefficient was significantly different from zero (0). The chi-square goodness of fit test showed that the overall model was statistically significant (chi-square of 30.045, p>.05). Therefore I rejected the null hypothesis. The Pseudo R^2 was low (indicating that the unprotected sex variable explained only 5.6% of the variance in HIV status). The DR^2 was low, signifying that the model was an excellent fit for my data. I concluded that the overall fit was relatively good.

Table 8.

Association Between Unprotected Sex and HIV Status

Variable	Odds ratio (95% CI)	*p*-value
Unprotected sex	.622 (0.320, 0.924)	*p* = < 0.001

From the above Table 8, it appeared that HIV status was significantly predicted by unprotected sex. Looking at the above table, the calculation of unprotected sex yielded an odds ratio (*OR*) of 0.622, 95% CI [0.332, 0.924], statistically significant: p<.001. *OR* < 1 implied a negative association and indicated that being HIV positive is less likely to occur in the group that had protected sex, which means that those who had protected sex had lower odds of being HIV positive. Besides, the CI never crossed 1 (one), meaning unprotected sex is a good predictor of HIV status. Therefore, the odds of being HIV positive among those who had unprotected sex were 62% higher than those who had protected sex with the study sample population effect between 32% and 92%. This result was statistically significant.

Thus, I rejected the null hypothesis in favor of the alternative hypothesis that there was an association between unprotected sex and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya. I consequently rejected the null hypothesis because the study sample population's differences did not occur by chance. Rejecting the null hypothesis signified that my study sample offered adequate evidence to deduce that the effect occurred.

Research Question 3

Association between age and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya. I analyzed the association between age and HIV status using bivariate logistic regression. The sample included 936 males aged 18-49 years from Homa Bay County, Kenya. Out of these, 29.5% were between ages 18-24, 33.4% between ages 25-31, 21.5% between ages 32-38, 12.8% between ages 39-45, 2.8% between ages 46-49 years. I analyzed the data for both groups (cases and controls). Standardized beta values (B), Pseudo R^2, and the DR^2 were accounted for in the model. I reported the results as odds ratios, confidence interval (CI), and corresponding p-values to identify if age was independently associated with HIV status.

Table 9.

Outline of Logistic Regression Analysis for Age and HIV Status

Variable	B (SE)	Exp(B)	95% CI
Age group [0 = 18 - 24]			
Age group(1) [1 = 25 - 31 years]	-1.139 (0.212)	0.320***	(0.211, 0.486)
Age group(2) [2 = 32 - 38 years]	-0.260 (0.204)	0.771*	(0.517, 1.151)
Age group(3) [3 = 39 - 49 years]	-0.135 (0.222)	0.874*	(0.566, 1.350)
Constant	0.446 (0.170)	1.561***	

Note: R2 =.048 (Cox and Snell), .064 (Nagelkerke). Model $\chi 2$ (3) = 1251.748, *p* < .05. **p* > .05; ***p* < .05; ****p* < .001

The Exp(*B*) for age between and “25-31” years were statistically significant. At the same time, the Exp(*B*) for the other age groups were not statistically significant. I can conclude that age between “25 - 31” years was significantly associated with HIV status while the rest of the other age groups were not statistically significant. The Exp(*B*) and the direction of the beta values inform us that ages between 25 to 49 years relationship with the dependent variable was negative (See Table 9). Based on the negative beta values, the relationship was the reverse. Meaning, one positive increase in age group increased the likelihood of an HIV positive event by 1.561 times while holding other predictors in the model constant. Therefore, an increase in age resulted in an increase in the probability of HIV positive event.

Because all the predictor categorical variables (apart from age between 25-31 years) were not significant, therefore, their coefficients were not significantly different from zero (0). The chi-square goodness of fit test showed that the overall model was statistically significant (chi-square of 45.823, p<.005). Therefore I rejected the null hypothesis. The HL test, p>0.05, indicating that the model was a good fit for my data (however, this did not mean the model fits well). The Pseudo R^2 =.066 (indicating that the age variable explained only 6.6% of the variance in HIV status. R^2 was small (indicating a poor regression model did not fit my observations). The DR^2 was high, signifying that the model was good but not great. I concluded that the overall fit was relatively poor.

Table 10.

Association Between Age and HIV Status

Variable	Odds Ratio (95% CI)	*p*-value
Age	1.754 (1.336, 2.171)	p = < 0.001

From the above Table 10, it appeared that the age of the respondent significantly predicted HIV status. The calculation of the OR for the age yielded an odds ratio (*OR*) = 1.754, 95% CI [1.336, 2.171], statistically significant: $p<.001$. The *OR* >1 signifies the increased occurrence of being HIV positive with increased age (meaning one unit increase in the age group will result to increase in the likelihood of an HIV positive event). The odds of being HIV positive in the sample population among those between the age group "39-49" years were 1.754 times higher than those between the age group "18 - 24" years. This result was statistically significant.

I rejected the null hypothesis in favor of the alternative hypothesis that there was an association between age and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya. Thus, the differences among the study sample population did not occur by chance. Rejecting the null hypothesis signified that my study sample offered adequate evidence to deduce that the effect occurred.

Research Question 4

Association between the number of sexual partners and HIV status among circumcised males aged 18-49 years in Homa Bay County. Kenya. I analyzed the association between the number of sexual partners and HIV status using bivariate logistic regression. The sample included 936 males aged 18-49 years from Homa Bay County, Kenya. The mean total number of non-marital sexual partners was 1.48 [±1.55], with a range between zero (0) to 16 partners. I analyzed the data for both groups (cases and controls). Standardized beta values (B), Pseudo $R^{2,}$ and the DR^2 were accounted for in the model. I reported the results as odds ratios, confidence interval (CI), and corresponding p-values to identify if the number of sexual partners is independently associated with HIV status.

Table 11.

Outline of Logistic Regression Analysis for Number of Sexual Partners and HIV Status

Variable	B (SE)	Exp(B)	95% CI
Number of sexual partners	.025 (.045)	1.134**	(1.038, 1.238)
Constant	-.186 (.093)	0.830**	

Note. R^2 =.009 (Cox and Snell), .012 (Nagelkerke). Model $\chi^2(1) = 1287.954$, $p < .05$. *p > .05, **p < .05

The Exp(*B*) and the direction of the beta values inform us that the number of sexual partners relationship with the dependent variable was positive (See Table 11). Based on the positive beta values for the number of sexual partners, the relationship is not reverse. Meaning, one (1) unit increase in number of sexual partners will increase the probability of being HIV positive by 1.134 times while holding other predictors in the model constant. Because the number of sexual partners' variable was significant, therefore, the coefficient was significantly different from zero (0). The chi-square goodness of fit test showed that the overall model was statistically significant (chi-square of 8.230, $p<.05$). Therefore I rejected the null hypothesis. The HL test, $p>0.05$, indicating that the model was a good fit for my data (however, this did not mean the model fits well). The Pseudo R^2 =.012 (R^2 was small, indicating that a poor regression model did not fit my observations). DR^2 is high, signifying that the model is good but not great. I conclude that the overall fit was relatively poor.

Table 12.

Association Between Number of Sexual Partners and HIV Status

Variable	Odds ratio (95% CI)	*p*-value
Number of Sexual Partners	0.454 (0.366, 0.542)	p = 0.005

From the above Table 12, it appears that the number of sexual partners that significantly predicts HIV status. The calculation of the number of sexual partners yielded an odds ratio (*OR*) of *OR* = 0.454, 95% CI [0.366, 0.542], p = 0.05, which was statistically significant. This means that the number of sexual partners was significantly associated with HIV status. *OR* < 1 implies a negative association and indicates that being HIV positive is less likely to occur in a group with fewer sexual partners. An increase in one unit (one sexual partner) increases the likelihood of being HIV positive by

13%. A circumcised male with zero (0) non-marital sexual partner was 45% less likely to be HIV positive than a circumcised male with 16 sexual partners. We can say that having a higher number of sexual partners was a significant risk of being HIV positive.

I rejected the null hypothesis in favor of the alternative hypothesis that there was an association between the number of sexual partners and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya. The differences among the study sample population did not occur by chance. Rejecting the null hypothesis signified that my study sample offered adequate evidence to deduce that the effect occurred.

Research Question 5

Association between relationship status and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya. I examined the association between relationship status and HIV status. The sample included 936 males aged between 18 - 49 years from Homa Bay County, Kenya. A total of 5 relationship status were recorded ranging from Marital 24.4% (*n* = 228), Stable 18.2% (*n* = 170), Casual 10.1% (*n* = 94), and Multiple partners relationships 47.4% (*n*=443). I analyzed the data for both groups (cases and controls). Standardized beta values (B), Pseudo R^2, and the DR^2 were explained in the model. The results are reported as odds ratios, confidence interval (CI), and corresponding p-values to identify if relationship status is independently associated with HIV status.

Table 13.

Outline of Logistic Regression Analysis for Relationship Status and HIV Status

Variable	B (SE)	Exp(B)	95% CI
Relationship status [0=Multiple relations]			
Relationship status(1) [1 = Marital]	-0.654 (0.165)	**0.520*** **	(0.376, 0.718)
Relationship status(2) [2 = Stable]	-0.937 (0.186)	**0.392*** **	(0.272, 0.564)
Relationship status(3) [3 = Casual]	-0.795 (0.231)	**0.452*** **	(0.287, 0.711)
Constant	0.407 (0.097)	1.503***	

Note. R^2 =.038 (Cox and Snell), .051 (Nagelkerke). Model $\chi^2(3) = 1259.748$, $p < .05$.
*** < .001

The Exp(*B*) and the direction of the beta values inform us that the dependent variable's relationship status varied much. Based on the negative beta values for the marital, stable, and casual relationship status, the relationship is not reverse. Meaning, an increase (change from marital to multiple partner relationship statuses) will increase the probability of being HIV positive by 52% while holding other predictors in the model constant. Detailed analysis of Table 13 indicates that the Exp(B) for Marital, Stable, and Casual relationship status was less than 1. While Multiple partner's relationship statuses yielded an Exp(B) > 1, meaning it’s more harmful to have Multiple partners relationship status, as it increased the likelihood of being HIV positive. Worth noting is that all the CI (for those who had marital, stable, and casual relationship status) never crossed one, meaning that there was a difference between cases and the study's control arms with the change in different types of relationship status.

Because all the categorical predictor variables were significant, therefore, the coefficients were significantly different from zero (0). Looking at the Chi-Square goodness of fit test, the overall model was statistically not significant. Hence, I rejected the null hypothesis. The HL test, p>0.05, indicating that the model was a good fit for my data (however, this does not mean the model fits well). The Pseudo R^2 =.051 (R^2, was small, indicating a poor regression model did not fit my observations). The DR^2 was high, signifying that the model was good but not great. I conclude that the overall fit was relatively poor.

Table 14. Association Between Relationship Status and HIV Status

Variable	Odds ratio (95% CI)	*p*-value
Relationship status	1.535 (1.203, 1.868)	p = 0.001

The calculation of the relationship status produced odds ratio (*OR* 1.535, 95% CI [1.203, 1.868], p = < 0.001, which was statistically significant. The *OR* greater than one (1) implies a positive association, indicating that change from marital to multiple partners relationship status increases the probability of being HIV positive by 1.535 times. It also indicated that it’s more harmful to have multiple partner relationship status.

Table 14 above shows that the relationship status significantly predicted HIV status. Therefore, I rejected the null hypothesis that there was no association between relationship status and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya. Failure to reject the null hypothesis, signified that my study sample offered adequate evidence to deduce that the effect occurred. Hence, I supported the alternative hypothesis.

Research Question 6

Association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya, controlling for engaging in unprotected sex, age, number of sexual partners, and relationship status. I further investigated the association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya, controlling for engaging in unprotected sex, age, number of sexual partners, and relationship status. First, I applied bivariate logistic regression devoid of adjusting for the effect of independent variables in previous binary logistic regressions in RQ1 –RQ5, and after adjusting or controlling for the effects of unprotected sex, age, the number of sexual partners, and relationship status to identify factors associated with HIV status. This was followed by stepwise backward logistic regression analysis to account for any unique variance above what was accounted in previous binary logistic regressions. The sample included 936 males aged 18-49 years. Only variables with a statistical significant association of p-value < 0.05 in bivariate analyses above were considered for final binary logistical model in step 1. However, I retained belief about VMMC, although the p-value was >.05. Standardized beta values (B), Pseudo R^2, and the DR^2 were accounted for in the model. I reported the results as odds ratios, confidence interval (CI), and corresponding p-values to identify variables independently associated with the dependent variable for all the predictors in all the regression models.

Stepwise backward elimination method. In the final model, I used the stepwise backward elimination method for all the variables irrespective of the statistical significant association of p-value < 0.05 in the bivariate analyses in RQ1-5 (See Table 15 below). Nagelkerke R^2 provided an estimation of variance explained. I tested any interactions within each stepwise model. I utilized the crude *OR* and *p*-value to approximate the strength of the association between covariates and HIV status. I weighted all the analysis for non-randomized characteristics and the likelihood of nonresponse. I conducted additional analysis to measure inter-item correlation and factor analysis. This included adjusting for the effects of potential confounding variables at all stratified levels.

Table 15.

Outline of Binary Logistic Regression Analysis for Predictor Variables and HIV Status

Variable	B (SE)	Exp(B)	95% CI
Belief about VMMC [0 = Complete protection]			
Belief about VMMC(1) [1 = Partial protection]	0.473 (0.415)	1.605*	(0.712, 3.620)
Belief about VMMC(2) [2 = No protection]	0.325 (0.341)	1.383*	(0.709, 2.700)
Belief about VMMC(3) [3 = Don’t know]	0.007 (0.427)	1.007*	(0.436, 2.323)
Unprotected Sex(1) [0 = no, 1 = yes]	-0.954 (0.170)	0.385***	(0.276, 0.537)
Age group [0 = 18-24]			
Age group(1) [1 = 25-31 years]	-1.192 (0.273)	0.304***	(0.178, 0.519)
Age group(2) [2 = 32-38 years]	-0.197 (0.261)	0.821*	(0.492, 1.369)
Age group(3) [3 = 39-49 years]	-0.137 (0.281)	0.872*	(0.503, 1.513)
Number of sexual partners	0.020 (0.056)	1.02*	(0.914, 1.139)
Relationship status [0 = Multiple partners]			
Relationship status(1) [1 = Stable]	-0.656 (0.224)	0.519**	(0.334, 0.805)
Relationship status(2) [2 = Casual]	-0.431 (0.262)	0.65**	(0.389, 1.085)
Constant	0.934 (0.412)	2.545**	

Note: R2 =.138 (Cox and Snell), .184 (Nagelkerke). Model $\chi 2(8) = 873.987$, p > .05. *p > .05; **p < .05; ***p < .001

The Exp(B) for unprotected sex, age groups between “18 - 24” years, and stable and casual relationship status were statistically significant. In contrast, the Exp(B) for the number of sexual partners was not statistically significant in the expanded model. Based on the negative beta values for the unprotected sex, age, and relationship status, had a negative relationship with HIV status (reverse). Meaning, an increase in unprotected sex, age, and relationship status variables will lead to an increase in the probability of being HIV positive event.

Not all the predictor variables were statistically significant; therefore, the coefficients were not significantly different from zero (0). The chi-square goodness of fit test showed that the overall model was statistically significant (chi-square of 3.759, p>.005). The *HL test*, p>0.05, indicating that the model was a good fit for my data (however, this does not mean the model fits well). The Pseudo R^2 =.184 (R^2 was medium indicating a good regression model fitted well by my observations). DR^2 was high, signifying that the model was good but not great. I conclude that the overall fit was relatively good.

Table 16.

Association Between Predictor Variables (Belief About Voluntary Medical Male Circumcision, Age Group, Unprotected Sex, Number of Nonmarital Sexual Partners, and Relationship Status) and HIV Status

Variable	Odds ratio (95% CI)	*p*-value
Belief about VMMC	1.698 (0.925, 2.471)	$P = 0.478$
Unprotected sex	.278(-0.055, 0.611)	$p = < 0.001$
Age	1.150 (0.617, 1.682)	$p = < 0.001$
Number of sexual partners	.505 (0.395, 0.615)	$P = 0.721$
Relationship status	0.735 (0.259, 1.211)	$p = < 0.010$

Table 16 above shows that belief about VMMC did not significantly predict HIV status while controlling for unprotected sex, age, and the number of sexual partners. This yielded an *OR* = 1.698 CI [0.925, 2.471], $p = 0.478$, which was not statistically significant.

In this expanded logistic regression model, the *OR* for unprotected sex was reduced to *OR* = 0.278 but remained less than one and statistically significant: $p < .001$. The reduction in the OR indicated that there was interaction in this expanded model. *OR* < 1 implies a negative association and indicates that being HIV positive is less likely to occur in the group that had protected sex. The odds of being HIV positive in the sampled population among those who had unprotected sex were 72.2% higher than those who had protected sex in this expanded model. This result was statistically significant.

Likewise, the OR for the age decreased to *OR* = 1.150 from *OR* = 1.754 in the previous binary logistic regression, indicating some interaction. As shown in Table 16, it appeared that the age of the respondent significantly predicted HIV status. *OR* >1 signifies the increased occurrence of HIV positive (with the increased age). Therefore, the odds of being HIV positive in the sample population among those aged between "39-49" years were 1.15 times more than those between the age group "18-24" years. This result was statistically significant. Based on the negative beta values for the age group 25-49 years, the relationship is the reverse. Meaning, an increase in the age group will result in an increased likelihood of being HIV positive.

In this model, the *OR* for the number of sexual partners increased to *OR* = 0.505 (p = 0.721) from *OR* = 0.454 (p = 0.005) in the previous model in RQ4. *OR* < 1 implies a negative association and indicates that HIV positive was less likely to occur in the group with fewer sexual partners. However, this was not statistically significant. The change in *OR* and significance level in this expanded model indicated that there were some interactions.

The *OR* for relationship status increased in the expanded model to *OR* = 0.735 from 1.535, but remained greater than one and statistically significant: $p < .010$. The increase in the *OR* indicated that there was interaction in this expanded model. The *OR* greater than one (1) implied a positive association and indicated that being HIV positive is more likely to occur in the group that multiple partners relationship status. The odds of being HIV positive in the sampled population among those with stable relationship status were 73% higher than those who had a stable relationship status in this expanded model. This result was statistically significant.

I failed to reject the null hypothesis that there is no association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay

County, Kenya, controlling for engaging in unprotected sex, age, number of sexual partners, and relationship status. I failed to reject the null hypothesis (p = 0.310).

In the expanded stepwise logistic regression model, I noticed that the *-2 Log-Likelihood* statistics had changed much (from 1290.343 to 873.987), indicating that my expanded model was doing a better job at predicting decision on HIV status than was my one-predictor model. The Pseudo R^2 statistics have also increased from .010 to .184. I also observed that the *OR* for belief about VMMC, age, and the number of sexual partners increased slightly. At the same time, the *OR* for unprotected sex and relationship status decreased in the expanded model, indicating that there was some interaction or moderation. The observed large values of the *-2 Log-Likelihood statistics* in the expanded logistic regression model further indicate that the two expanded statistical models are poorly fitting.

Table 17.

Summary Table for All Research Questions –Null Hypothesis (Rejected or Failed to Be Rejected)

RQ#	Research Question	Null hypothesis
RQ1	What is the association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?	Failed
RQ2	What is the association between engaging in unprotected sex and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?	Rejected
RQ3	What is the association between age and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?	Rejected
RQ4	What is the association between the number of sexual partners and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?	Rejected
RQ5	What is the association between relationship status and HIV status among circumcised males aged 18-49 years in Homa Bay County?	Rejected
RQ6	What is the association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya, controlling for engaging in unprotected sex, age, number of sexual partners, and relationship status?	Failed

Summary

Among my respondents, males aged between 39 -49 years that practiced unprotected sex with a greater number of sexual partners and multiple sexual partners' relations were more likely of being HIV positive. In the next section, I will provide a broader discussion of this study results, and its inference for predicting HIV status will be exhibited in chapter 5. In the next chapter, I will also analyze and review the findings and possible links of inquiry this study has produced, including interpretation of the results in the context of the theoretical and conceptual framework. I will also present the study limitations, threats to validity, recommendations for action, and positive social change implications.

Chapter 5: Discussion, Conclusion, and Recommendations

Introduction

Unprotected sex has been and remains a significant public health risk for the people of Homa Bay County, Kenya. The county reported an HIV prevalence rate of 26%, which is the second-highest in the nation and almost 4.5 times greater than the nationwide average (NACC, 2016). In 2015, the county reported about 15,003 new HIV infections, which is among the highest in the country (NASCOP, 2016). Confusion from social marketing concerning the outcome of partial protection of VMMC in Sub-Saharan Africa (Kibira et al., 2016), coupled with advances in HIV treatment, has created false beliefs among males and females concerning their perceptions of risk of HIV and STD transmission and susceptibility (Dwyer-lindgren et al., 2019; Machacha, 2015). Lack of clarity of whether there is any possible significant association between belief about VMMC, unprotected sex, age, number of sexual partners, and relationship status with HIV status in Homa Bay County, Kenya, remained to be answered, which led to this research study.

I used the quantitative approach and employed a case-control method to establish whether there were any differences between belief about VMMC, unprotected sex, age, number of sexual partners, relationship status, and HIV status among circumcised males aged between 18-49 years in Homa Bay County, Kenya. The dependent variable was HIV status, which was coded as 0/1 (no/yes) in both groups. The independent variables were beliefs about VMMC (perception about partial and full/complete protection), unprotected sex, age, number of sexual partners, and relationship status.

The study intended to establish the answers to the following research questions:

RQ1: What is the association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

$H_0$1: There is no association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

H_a1: There is an association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ2: What is the association between engaging in unprotected sex and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

$H_0$2: There is no association between engaging in unprotected sex and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

H_a2: There is an association between engaging in unprotected sex and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ3: What is the association between age and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

$H_0$3: There is no association between age and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

H_a3: There is an association between age and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ4: What is the association between number of sexual partners and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

$H_0$4: There is no association between number of sexual partners and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

H_a4: There is an association between number of sexual partners and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ5: What is the association between relationship status and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

$H_0$5: There is no association between relationship status and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

H_a5: There is an association between relationship status and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya.

RQ6: What is the association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya, controlling for engaging in unprotected sex, age, number of sexual partners, and relationship status?

$H_0$6: There is no association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya, controlling for unprotected sex, age, number of sexual partners, and relationship status.

H_a6: There is an association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya, controlling for unprotected sex, age, number of sexual partners, and relationship status.

The results were evident: four out of six alternative study hypotheses were sustained in all cases. However, I failed to reject two null hypotheses. I found no association between belief about VMMC and HIV status, and in aggregate (when stratified by unprotected sex, age, number of sexual partners, relationship status, and HIV status) among circumcised males aged 18-49 years in Homa Bay County. I can conclude that belief about VMMC and aggregate (when stratified by unprotected sex, age, number of sexual partners, and relationship status) were not associated with HIV status. However, the results supported the alternative hypothesis that there was an association between engaging in unprotected sex, age, number of sexual partners, relationship status, and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya. The findings indicated that unprotected sex, age, number of sexual partners, and relationship status were significant predictors of HIV status.

Interpretation of the Findings

This case-control study results are in agreement with the results of the majority of the studies conducted in Sub-Saharan Africa and globally. The findings are also detailed and established compared to any specific research conducted in VMMC and the risk of HIV infection in Kenya. In this section, I present the interpretation of this case-control study's results and contrast them with global and regional research, referring to the six research questions, which were as follows.

Research Question 1

RQ1: What is the association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

The results indicated that there was no association between beliefs about VMMC and HIV status. From the analysis, I discovered that those who believed in complete protection from VMMC had 1.53 times the odds of being HIV positive compared to those who believed in partial protection from VMMC (*OR* = 1.533, 95% CI [0.933, 2.133], *p* = 068). The odds of being HIV positive in the sampled population among those who believed that VMMC provided complete protection was 58% times higher than those who believed that VMMC provided partial protection. The results were not statistically significant. These findings are in disagreement with previous studies conducted by Schaefer et al. (2019), Westercamp et al. (2014), and Wilson et al. (2014). They indicated an association between previous and/or baseline beliefs about VMMC and the risk of HIV infection. Wilson et al. argued that condom use was moderated by an individual’s baseline beliefs prior to receiving VMMC. Schaefer et al. indicated that social norms about VMMC were barriers to HIV prevention. This was further supported by Westercamp et al., who reported that beliefs about VMMC were associated with behavioral disinhibition among recently circumcised men in Nyanza, Kenya. Although the above authors found some association between beliefs about VMMC and increased risky sexual behaviors and HIV infection, this study failed to prove such associations among the sampled population in Homa Bay County, Kenya.

The findings of this study are further not in agreement with the study conducted by L'Engle et al. (2014), who argued that when circumcised males think that they have 100% protection from HIV risk after VMMC, they could become involved in risky sexual behaviors because they may believe they no longer have any likelihood of HIV infection (L'Engle et al.,2014, p.128).

This study has, therefore, underplayed the role of belief about VMMC in HIV infection. My study concurred with other studies conducted by Gurman et al. (2015) and Wagunda & Agalo (2016), who indicated the role played by belief about VMMC on HIV infection was unclear. Humphries et al. (2015) and Layer et al. (2013) reported misconceptions due to the social desirability among the circumcised males and their partners on the level of protection provided by VMMC against HIV transmission and the decreased risk of HIV and other STDs. Layer et al. contended that this overstated belief in the overall public health benefits provided by VMMC could lead to a situation in which women may be involved in unprotected sex with circumcised men. Abbott et al. (2013) reported that circumcised men were using their circumcision status to convince female sex workers to forgo condom use due to the perceived heightened protection provided by circumcision. This argument was further supported by Humphries et al. (2015) in their study conducted in KwaZulu-Natal, South Africa, in which they reported that some circumcised males perceived that their circumcision status allowed them to have multiple sexual partners, extra sex and that VMMC provided them with adequate protection from HIV risk and therefore condoms could only be required to prevent pregnancy.

However, this case-control study showed that belief about VMMC did not significantly predict the HIV status. Zungu et al. (2016) argued that the benefit gained from VMMC prevention intervention could be compromised if not complemented with the change in social and risk behavior. L'Engle et al. (2014) suggested a need for effective male circumcision counseling for alleviating HIV risk behaviors. This opinion is supported by other researchers who have recommended the urgent need to develop a communications strategy to tackle the misconceptions about VMMC and to encourage HIV protective methods (L'Engle et al., 2014) in attaining the goal of "getting to zero" for new HIV infections (Kamath & Limaye, 2015). As VMMC gains momentum in Homa Bay County, Kenya, there is a need to prioritize campaigns on HIV prevention strategies to complement VMMC efforts. This could contribute to future reductions in new HIV infections and reductions in the economic burden related to STDs and HIV care and treatment.

Research Question 2

RQ2: What is the association between engaging in unprotected sex and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

The results indicated that unprotected sex significantly predicted HIV status. The findings showed that those who had unprotected sex are almost 62% times more at risk of being HIV positive than those who had protected sex (*OR* = 0.622, 95% CI [0.320, 0.924], *p* = <0.001, statistically significant). This study's result is in agreement with the studies conducted by Du et al. (2016) and Lemme, Doyle, Changalucha, Andreasen, & Baisley (2013). They reported that there was an association between unsafe sex and HIV status. The results of this study were also in agreement with the findings of a meta-analysis conducted by Patel et al. (2014). They analyzed 7,339 abstracts and reported a statistically significant association between unprotected sex and the risk of HIV infection. In this study, I reported a consistent condom use of 50.2%, which was consistent with the results of another study conducted by UNAIDS (2016) on protected sex in Sub-Saharan Africa that reported condom use of 50% amongst males with numerous sexual relationships.

Based on the negative beta values for unprotected sex, the relationship is the reverse, meaning, unprotected sex increases the probability of being HIV positive. We can say that unprotected sex is a *significant* risk of being HIV positive. This finding is also coherent with studies conducted by Papas et al. (2018) and Yasel Manuel et al. (2019), who indicated a strong association between unprotected sex and HIV. The result of this study suggests that unprotected sex puts males in Homa Bay County, Kenya, at high risk of acquiring HIV infection. Furthermore, the findings state that unprotected sex can be used to predict being HIV positive.

Research Question 3

RQ3: What is the association between age and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

The finding showed that age was a significant predictor of HIV status. The calculation of the OR for age yielded an odds ratio of (*OR* = 1.754, 95% CI [1.336, 2.171], statistically significant: $p < .001$. $OR > 1$ signifies the increased occurrence of being HIV positive with increased age (meaning there is a higher likelihood of being HIV positive with an increase in age). The odds of being HIV positive in the sampled population among those between the age group “39-49” were 1.754 times higher than those between the age group “18-24” years. This study reported a significant association between age 25-31 years and HIV status. This result is in agreement with another study done by Kim et al. (2016) among males aged 15 - 64 years. Kim et al. reported a strong association between males aged below 30 years and being HIV positive compared to the rest of the other age groups (between 31-64 years). In comparison, Kembo & Kembo (2012) reported a strong association between younger females aged 15-24 years and HIV infection. My study finding is also in agreement with Freeman & Anglewicz (2012), who supported that HIV prevalence increased with age. In contrast, Freeman & Anglewicz reported that men aged between 50-64 years were more likely to be HIV positive compared to men aged 15-49 years.

This study's results are also in agreement with the research study conducted by Saffier, Kawa, & Harling (2017), who indicated that HIV status was not statistically significantly predicted by other age groups (from 31 -60 years) compared to the age group between 15-30 years. Besides, the results of this study are in agreement with previous studies by Prati et al. (2015), McKay et al. (2017), and Rennie et al. (2015), who indicated that age was a risk factor to HIV infection. Paterno & Jordan (2012) argued that unprotected sex and HIV infection increased with an increase in age. The above studies are further supported by the findings of a study conducted in China by Qun et al. (2018)

who indicated that there was a significant association between older men (aged > 50 years) and HIV infection compared younger men (aged < 50 years). It would be interesting to understand why my study did not find any significant association between ages 32- 49 years and HIV infection, while I found out that HIV infection increases with increased age.

Research Question 4

RQ4: What is the association between number of sexual partners and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

The results indicated that the number of sexual partners significantly predicted HIV status (*OR* = 0.454, 95% CI [0.366, 0.542], *p* = 0.005). Hence, I rejected the null hypothesis. *OR* < 1 implies a negative association and indicates that being HIV positive was less likely to occur in the group with fewer sexual partners. The result is in agreement with Smith et al. (2014), who reported that in Sub Saharan Africa, multiple sexual relationships, usually referred to as sexual concurrency, is the main driver of heterosexual HIV transmissions in areas and populations highly affected by AIDS (Grangeiro et al., 2015; Kalichman & Grebler, 2010). This study also supported the research by Carlos et al. (2017), who reported an association between multiple concurrent sexual relationships and HIV seropositivity.

Various researchers have also indicated that sexual concurrency contributes to the fast spread of HIV infections in Sub-Saharan Africa (Kalichman & Grebler, 2010; Rositch et al., 2014). These findings are further supported by another study conducted in Johannesburg, South Africa, titled “If they have a girlfriend, they have five girlfriends”

(Mcvittie et al., 2018). Mcvittie et al. reported a strong association between the number of sexual partners and HIV infections. Whereas Kenyon et al. (2018) argued that there was a strong association between the number of lifetime partners contributing to the variation of HIV prevalence in the Sub-Saharan region. These findings are further supported by Obel et al. (2014), who reported a significant association between the mean number of sexual partners, the incidence of concurrent partners, and HIV infection. These findings agree with this study, which concluded that that multiple sexual partner, whether concurrent or sequential, plays a significant role in the HIV epidemic in Homa Bay County, Kenya.

Research Question 5

RQ5: What is the association between relationship status and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya?

The results indicated that the relationship status of sexual partner(s) was a significant risk to HIV status (*OR* = 1.535, 95% CI [1.203, 1.868], p = < 0.001), hence, I rejected the null hypothesis. The *OR* greater than one (1) implies a positive association, indicating that change from marital to multiple partners relationship status increases the probability of being HIV positive by 1.535 times. It also indicated that it was more harmful to have multiple partners. Few studies have compared the association between relationship status and HIV status among circumcised males. The majority of existing literature studied the association between relationship status and condom use rather than with HIV status (Alamrew et al., 2013; Rennie et al., 2015). Although it's generally agreed that consistent condom use is associated with reduced risk to HIV infection, this study measured the association between relationship status and HIV status.

The findings agree with research conducted in South Africa that indicated an association between relationship status (especially marital status) with reduced HIV infection (Shisana et al., 2016). The author reported low HIV prevalence among those who were married and high HIV prevalence among those who were cohabiting compared to other marital status groups. Nevertheless, Shisana et al. did not look at all types of relationship status. Tlou (2019) reported that relationships and other socio-demographic variables, were associated with HIV infection.

These study findings are not in agreement with the study conducted in South Africa, which found no association between relationship status and HIV status (Shisana et al., 2004). The authors argued that the risk of HIV infection did not differ significantly by relationship status. This is further supported by other authors that demonstrated that most HIV infections do happen among married and cohabiting partners (Montgomery et al., 2012). Therefore, the dyadic role (the risk environment) played by relationship status should not be undermined. This was further supported by this study that found a significant association between relationship status and HIV status.

Research Question 6

> RQ6: What is the association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay County, Kenya, controlling for engaging in unprotected sex, age, number of sexual partners, and relationship status?

I failed to reject the null hypothesis that there was no association between beliefs about VMMC and HIV status among circumcised males aged 18-49 years in Homa Bay

County, Kenya, controlling for engaging in unprotected sex, age, number of sexual partners, and relationship status. This finding was not statistically significant ($p = 0.310$).

In the expanded stepwise logistic regression model, the *OR* for belief about VMMC increased to 1.698 from 1.533 in the binary model RQ1. However, both the *ORs* were not statistically significant. The OR increase indicates some form of multiplicative interaction of predictors (Kruschke, 2015) based on the additive combination of the other covariates included in the expanded model. Likewise, the *OR* for unprotected sex decreased from .622 to .278, indicating that there might have been some multiplicative interaction of predictors in the expanded model. This indicated that in the expanded model, the odds of being HIV positive in the sampled population among those who had unprotected sex were 73% higher than those who had protected sex, compared to 38% without the multiplicative interaction in the binary model. This result was statistically significant. The *OR* for the age also decreased to *OR* = 1.150 from *OR* = 1.754 in the previous binary logistic regression, indicating some interaction. This is in agreement with the studies by Prati, Mazzoni, & Zani (2015) and Saffier, Kawa, & Harling (2017), who reported some multiplicative interaction with other covariates in the equation. The *OR* for the number of sexual partners increased to *OR* = 0.505 ($p = 0.721$) in the expanded model from *OR* = 0.454 (p = 0.005) in the previous model in RQ4. In the binary model in RQ4, the association between the number of sexual partners and HIV status was significant, while in the expanded model, the association in non-significant. The change in *OR* and significance level in this expanded model indicates the multiplicative interactions. The change in the significant level indicates that there was a significant correlation between number of sexual partners and another variable in the equation. Finally, the *OR* for relationship status decreased from 1.535 to 0.735 in the expanded model.

Worth discussing is that, when the belief about VMMC, number of sexual partners, and relationship status were added in the model, I noticed a significant change in the -2 *Log-Likelihood statistics* (drop to 873.987 from 1290.343). This indicated that my expanded model was doing a better job at predicting decisions on being HIV positive than was my one-predictor model in the binary logistic regressions.

However, I also observed that the OR for unprotected sex, age, and relationship status decreased slightly in the expanded model of stepwise logistic regression. At the same time, the *OR* for belief about VMMC and the number of sexual partners increased, indicating that there was some interaction or moderation in the expanded model. The belief about VMMC remained statistically insignificant. Also, all the CI values for belief about VMMC crossed 1, meaning it was not a reliable predictor of HIV status. The observed large values of the *-2 Log-Likelihood statistics* in the stepwise model, is further indication that three statistical models are poorly fitting. These findings are in agreement with other studies that reported some moderation between the number of sexual partners, relationship status, and belief about VMMC and HIV infection in Sub-Saharan Africa (Cluver et al., 2016; Mckinnon & Abdool, 2016; Msango & King, 2019).

Analysis and Interpretation of the Findings in the Context of the Theoretical and Conceptual Framework

Introduction

I applied the HBM as a theoretical and conceptual framework for this research study. The HBM was founded on the belief that the behavior of those who received VMMC was based on the subjective value and the actual power to avert an HIV positive outcome (Glanz et al., 2008; Ramaprasad et al., 2014). The HBM has six key concepts: perceived vulnerability, severity, benefits to action and barriers to action; self-efficacy; and cues to action" (Tarkang & Zotor, 2015). I attempted to emphasize five HBM constructs and excluded cues to action. I did not focus on cues to action construct as the study could not measure the social network influences. Secondly, these five HBM constructs excellently explained the VMMC motivation, protected sex, and was used to examine the risk factors for HIV infection. I used the HBM to assess the behavioral and normative beliefs, their effect on attitude, and consequent influence on an individual's behavioral outcomes, the incentive to comply with protected sex, control beliefs, and apparent power to shun unprotected sex. The HBM was used to predict why individuals could seize an action (to have protected sex or want VMMC) to prevent HIV infection.

Using HBM in this research, I assumed that the lower the perceived susceptibility, severity, benefit, self-efficacy, and higher behavioral barriers, the lower the probability that the person will opt to take a specific health action (i.e., VMMC, protected sex, reduced number of sexual partners, and reduced risky sexual partnerships) to prevent HIV infection (Carpenter, 2010b; Glanz & Bishop, 2010; Ramaprasad et al., 2014). In this conceptual model, I assumed that knowledge of the desired behavior was essential to enhance self-protective behaviors on HIV prevention. By intensifying males' knowledge of the health risks linked with unprotected sex, they may have been motivated to consider or investigate their own behavioral risk (Rosenstock, 2005). The HBM has been extensively employed previously as the main theoretical framework in most health sciences research (Jones et al., 2016).

Perceived Susceptibility

Perceived susceptibility is also known as perceived vulnerability. It denotes a person’s perception of his susceptibility to acquiring the disease (Glanz et al., 2008; Janz & Becker, 1984; Stretcher & Rosenstock, 1997). Based on my HBM theoretical and conceptual framework, an individual must have considered that there was a probability of getting an HIV infection. When the perceived risk is high, an individual may opt for VMMC or condoms for extra protection (engaging in protected sex), reduce the number of sexual, or reduce risky sexual partnerships. A higher belief on VMMC efficacy could have led to reduced risk severity amongst the circumcised and may have led them to practice unprotected sex, with high-risk sexual partners, and have multiple sexual relationships.

In many studies, susceptibility has been reported to be the greatest powerful motivator for engaging in health-supporting behaviors (Ramaprasad et al., 2014; Rosenstock, 2000). In this study, Belief about VMMC, Unprotected sex, Number of sexual partners, and Relationship status were the variables that were used to measure susceptibility. The results indicated that Belief about VMMC variable was not significantly associated with HIV status. In contrast, unprotected sex and the relationship status variables were statistically significant in the binary logistic regression model both in isolation and after controlling for the other covariates. The number of sexual partners was significantly associated with HIV status in the binary logistic regression model in isolation. At the same time, after controlling for the other covariates, it did not remain significant. The findings are also consistent with previous studies that emphasized the role of perceived susceptibility in influencing the risk behavior (Crosby et al., 2002; Fonner et al., 2014; Khumsaen & Stephenson, 2017), such as unprotected sex and the number of sexual partners. However, the results were not consistent with the research article by Adams et al. (2014), who highlighted that perceived susceptibility to HIV infection did not predict HIV status. Thus, these study findings were inconsistent, as perceived susceptibility association with HIV status was not significant with all the variables. The results reinforced the application of HBM in interpreting HIV risk behaviors (including the unprotected sex, number of sexual partners', and relationship status variables) among circumcised males in Homa Bay County, Kenya. This study finding also informed us that circumcised males in Homa Bay County, Kenya, did not consider belief about VMMC as a threat to HIV infection.

Perceived Severity

As applied to this study, perceived severity described the personal biased assessment of the degree of severity/seriousness or perceived social impact of contracting HIV infection concerning morbidity and mortality associated with HIV infection (Glanz et al., 2008). Perceived severity might be comprised of the person's real health literacy, mythologies, and attitude about the HIV infection (Ramaprasad et al., 2014). The perceived threat results from the combination between susceptibility and severity of the illness (Glanz et al., 2008). Ramaprasad et al. (2014) reported a very strong association between susceptibility and action. Ramaprasad et al. indicated that the weaker the perceived severity, the lesser the acceptance of the desired action.

When the perceived threat is high, and the belief in the efficacy of VMMC is low, an individual could seek to reduce risky sexual behaviors. When the perceived threat of getting infected with HIV is low (in terms of individual evaluation of the possible consequences -including financial, biomedical, and social of pregnancy, acquiring STDs, HIV, and AIDS), an individual may engage in risky sexual behaviors (i.e., unprotected sex). This study measured perceived severity by using the variables' belief about VMMC and unprotected sex. Unlike unprotected sex, belief about VMMC was not significantly associated with HIV status in the binary logistic regression model both in isolation and after controlling for the other covariates. Therefore, my findings revealed an inconsistent association between perceived severity and HIV status. This finding is comparable to various studies (Khumsaen & Stephenson, 2017; Sánchez et al., 2011) and might be justified by the fact that circumcised males in Homa Bay County, Kenya, had low belief in the efficacy of VMMC. However, the finding disagrees with other studies (Gebru et al., 2018; Khumsaen & Stephenson, 2017), which revealed a strong association between perceived severity and HIV infection. Therefore, there is a need for further studies to assess whether there are other variables apart from unprotected sex, which can measure perceived severity as a risk factor of HIV infection.

Perceived Benefits

Perceived benefits denoted to a person's convictions that a specific act or behavior was effectual in producing definite advantage(s) (Carpenter, 2010b). The belief about VMMC variable and unprotected sex variables were used to measure the perceived benefit. Perceived benefit motivates an individual’s confidence in the efficacy of adopting health prevention actions (VMMC) to decrease the chances of HIV infection and avert the undesirable health outcome (Ramaprasad et al., 2014; Tarkang & Zotor, 2015). The individual may also opt for unprotected sex if he believes VMMC provides full/complete protection. This assumption could have resulted in a high possibility of engaging in protected sex. When the perceived value or positive aspect of engaging in protected sex with risky sexual partners (to avoid HIV and STDs) is high, an individual could have reduced risky sexual behaviors. Therefore, blended degrees of susceptibility and severity delivers the strength to undertake the action, and the awareness of the benefits (minus barriers) offer a favored course of action (Glanz et al., 2008).

Unlike unprotected sex, belief about VMMC was not significantly associated with HIV status in the binary logistic regression model both in isolation and after controlling for the other covariates. Therefore, my findings revealed an inconsistent association between perceived severity and HIV status. This finding further revealed that circumcised males in Homa bay County, Kenya, did not find any positive outcome of wanting VMMC and that it did not convince them to relate VMMC to the benefit of HIV prevention intervention. At the same time, I found unprotected sex to be a significant predictor of perceived benefit to action. Therefore, I can conclude that males in Homa Bay County, Kenya, may have adopted VMMC due to other factors, but not because of personal benefits derived from VMMC.

Perceived Barriers

Janz & Becker (1984) argued that barriers provide the greatest motivation for adopting health action. The benefits minus the barriers have been assumed to be the most significant predictors of taking preventive health behavior, such as VMMC (Carpenter, 2010). In comparison, perceived barriers suggest the conditions that prevent the individuals' belief from embracing or engaging in preventive health behavior (Rosenstock, 2005). In this study, belief about VMMC, age, and relationship status variables was used to measure perceived barriers to unprotected sex. High perception of VMMC efficacy and circumcision status could act as a barrier to protected sex. Perceived barriers related to wanting circumcision or protected sex may include relationship matters and emotional/psychological stress related to condom use/non-use: such decreased pleasure and reduced sensation in addition to concerns about adverse reactions from partners, pain, cost, etc. Age and relationship status could have influenced or modified sexual risk behaviors, level of risk perception, number of sexual partners, and, therefore, may have acted as a barrier to protected sex and wanting VMMC.

My findings revealed that belief about VMMC was not a significant predictor of HIV status in the binary logistic regression model both in isolation and when controlling for other covariates, while age and relationship status were significant predictors. Therefore, this study revealed that perceived barriers provided an inconsistent measure of the association with HIV status. This finding agrees with other research studies that reported the association between relations status and HIV status (Monsell & McLuskey, 2016; Muchiri et al., 2017). These authors argued that individuals in stable or marital relationships have a high likelihood of reporting non-condom use due to their perceived low risk of HIV infection. This argument is supported by my study findings, which revealed that belief about VMMC was not suitable measures of perceived barriers compared to age and relationship status in the association with HIV status.

Self-Efficacy

As described in this study, self-efficacy was the self-assurance in a person's capability to choose to implement a recommended action or behavior (Glanz et al., 2008), essential to generate the required HIV negative outcome (Ramaprasad et al., 2014). In this study, unprotected sex and the number of sexual partners were the variables used to measure self-efficacy. Self-efficacy was very instrumental in assessing the perceived behaviors that influence VMMC uptake and protected sex (Glanz et al., 2008). High confidence in an individual's ability to effectively insist on partner use of condoms (Condom use self-efficacy) was also assumed to have resulted in an increase in condom use/ less unprotected sex /have consistent condom use. High self-efficacy could have also led to a decrease in the number of sexual relationships, frequency of sexual acts, high belief about VMMC efficacy, and the type of relationships one had. Self-efficacy could be influenced or modified sexual risk behaviors and level of risk perception.

This study's findings showed that self-efficacy for protected sex behaviors was significantly associated with HIV status among the circumcised males in Homa Bay County, Kenya. Unprotected sex self-efficacy association with HIV status was strong in the binary logistic regression model both in isolation and when controlling for other covariates. Self-efficacy to reduce the number of sexual partners was strong in the binary logistic regression model in isolation but not after controlling for other covariates. Therefore, circumcised males in Homa Bay County, Kenya, were able to negotiate for protected sex and reduced the number of sexual partners to lower their risk for HIV infection. These findings reinforced the belief that self-efficacy would be the primary connection to protected sex and reduced the number of sexual partners' behavior and could have acted as a moderator to HIV risk behaviors (Khumsaen & Stephenson, 2017; Wulfert & Wan, 1993). The finding is also consistent with the argument that self-efficacy is the precursor of sexual risk behavior (Manika & Golden, 2011; Stretcher & Rosenstock, 1997; Zhao et al., 2012). This argument also supported the debates that perceive the self-efficacy as the main influencing factor to HIV prevention behaviors in Sub-Saharan Africa (Levy et al., 2019; Mwale & Muula, 2017). Notably, circumcised males in Homa Bay County, Kenya, who reported consistent protected sex, exhibited high self-efficacy in their sexual history in the last 12 months preceding the study compared to their peers who reported unprotected sex. Therefore, protected sex self-efficacy reduced the likelihood of HIV positive status. I can conclude that enhancing self-efficacy, especially for negotiating protected sex (condom use), may lead to reduced HIV infection among circumcised males in Homa Bay County, Kenya.

Conclusion

The use of HBM as a theoretical and conceptual framework to justify HIV and health behavioral change interventions has generated conflicting outcomes. Some researchers have supported the HBM in identifying and preventing risky HIV behaviors (Jeihooni et al., 2018; Tarkang & Zotor, 2015). At the same time, some researchers have argued HBM has generated mixed results (Karimy & Zareban, 2018; Schnall et al., 2015) or, occasionally, no effects while HBM concepts were evaluated for association with risks to HIV infection (Coulson et al., 2016; Ndabarora & Mchunu, 2014).

I discovered that some HBM constructs were statistically significantly associated with HIV status (Perceived susceptibility [especially for unprotected sex, number of sexual partners, and the relationship status variables]; perceived severity [unprotected sex]; perceived benefits [unprotected sex and age]; perceived barriers [relationship status]; and self-efficacy [unprotected sex and number of sexual partners]). The other HBM constructs were not statistically significantly associated with HIV status (perceived susceptibility [belief about VMMC]; perceived severity [belief about VMMC]; perceived benefits [belief about VMMC]; and perceived barriers [belief about VMMC]). Some of the HBM constructs' failure to explain the association with HIV status in this study after controlling for unprotected sex, age, the number of sexual partners, and relationship status. This implied that other factors apart from HBM constructs effectively described the HIV status (Coulson et al., 2016). For that reason, there is a need to expand to a more refined measurement model outside the HBM constructs when recognizing variables that predict HIV status. This would assist in designing tailored HIV interventions for males in Homa Bay County, Kenya.

Limitations of the Study

This research has limitations that are consistent with the limitations of case-control studies (Melamed & Robinson, 2018). Errors related to bias (recall and selection bias) and confounding were reflected in my research. First, my research was dependent on self-reported data. Due to the sensitivity of the nature of sexuality associated with this study, misrepresentation of the sexual behaviors was likely and could have contributed to social desirability bias. Social desirability could have resulted in an underestimation of the incidence and prevalence of unprotected sex, number of multiple or concurrent sexual partners, and type of partner relationships.

A good example is when I used the Timeline Follow Back (TLFB) approach. With this approach, with the cases (HIV positive participants), reports about their sexual histories may have been biased by their emotions regarding the sexual partner who may have transmitted them the disease. Hence, there may have been overstated possible relationship variations between cases and controls. Therefore, participants who were conscious of their new HIV seropositivity status may have presented biased histories. Further discussions on how I reduced the social desirability bias and self-reported data is under the next section on internal validity.

The second potential limitation, like most of the quasi-experimental designs, this study did not perform proper random sampling. There was a probability that selection (or "sampling") bias could have occurred, mainly when non-random sampling methods were used. There were circumstances where selecting a suitable source population using the incidence density sampling was problematic and may have contributed to selection bias.

Therefore the study may have produced relatively weaker evidence for the outcome (Creswell, 2009). Inadequate random sampling could have increased the probability of variances insignificant variables among the study groups. In addressing the above limitation due to selection bias and non-random sampling in the design and methodology, I attempted to control for supplementary variables, besides to the matching of participants to specific groupings (Frankfort-Nachmias & Nachmias, 2008), such as age and other features that may have affected the results (Wang, 2014) during data analysis. Lastly, I tried as much as possible to do random sampling were necessary during the selection of participants (Creswell, 2009) to deliver robust evidence and decrease the selection bias.

The third potential limitation was that, like other case-control study designs, this study did not explain any pre-existing factors and behavioral effects beyond the observation (Baird et al., 2014; Creswell, 2009). This was a limitation in the methodology. Nevertheless, the above limitation does not weaken the study design (Baird et al., 2014; McCambridge et al., 2014). Other factors that could have biased the results, for example, participant attrition and or refusal to participate, were dealt with during the analysis. This was achieved by conducting logistic regression models to examine whether there were any unusual differential characteristics between those who accepted to complete the study and the dropouts or those who refused to participate in the survey (Bartholomew et al., 2008). I also used logistic regression models to estimate the odds ratios for the descriptive variables for each group (cases and controls) relative to an odds ratio of an individual participant.

Finally, as established in the stepwise logistic regression, estimates of logistic regression interactions were affected by confounding bias (Liu et al., 2016). It appeared that a third factor might have distorted the association between covariates and outcome (HIV status) (Underhill, 2013). Confounding errors could have resulted in threats to the study's internal validity. I took specific considerations and strategies to address the errors to confounding to reduce threats to validity. These measures and strategies included using logistic statistical models after the data collection process to explain for the effect of interaction and confounding and avoided a Type I error (false positive) (Pourhoseingholi et al., 2012). I also looked at the research problem from several perspectives by selecting matching the study populations and research methods simultaneously (DiClemente et al., 2013). This included matching participants' characteristics by age group, which decreased threats due to confounding and other unforeseen factors in the control group.

Threats to Validity

External Validity

I screened all participants that met the inclusion criteria before sampling to reduce the likelihood of incomplete sampling frames, which could have posed a threat to external validity (Moons et al., 2012). I recorded all those who refused to participate and assessed whether their refusal biased the final results (Frankfort-Nachmias et al., 2015). During the analysis, I considered any unexpected and confounding factors that could have threatened the study's external validity. I also ensured that statistical conclusion validity and construct validity (Creswell, 2009) were taken care of during the findings' interpretation.

I used the following strategies to increase the generalizability of the results across the circumcised male population in Homa Bay County, Kenya. I tried as much as possible to conduct random sampling of participants recruited (when adequate numbers were available) across all the eight sub-counties to give full representation Homa Bay County, Kenya. I also used an incidence density sampling design to reduce the self-selection bias. I also ensured that the appropriate calculation of sample size and matched the participants by age from all the sub-counties to minimize threats to external validity. Besides, I adopted a consistent standard process in identifying the two groups based on HIV status (cases and controls) to reduce any threat to external validity (Bandera et al., 2013). The study inclusion criterion was based on the empirical gold standard in identifying HIV status. The use of different groups (such as cases and controls, age groups, and different relationship status) could also minimize threats owing to unforeseen and confounding factors (Frankfort-Nachmias et al., 2015).

Internal Validity

I attempted to maintain the internal validity of the study by using different strategies. DiClemente et al. (2013) indicated that the self-reported approach to data collection is the most appropriate method of investigating sexual behaviors. However, there was a high likelihood that social desirability bias could have emerged, either due to misreporting stigma or observer bias, which could have been a threat to the study’s internal validity. First, I ensured that social desirability was detected. Secondly, I used various strategies to address it, including designing the questionnaire in such a way that it had forced-choice items (Marx et al., 2011), where participants had no choice to consider on nonresponse. I also used the Timeline Follow Back (TLFB) approach and the interviewer-administered questionnaire to minimize bias. I also employed other strategies to enhance the validity of self-reported sexual behavioral data both within and across the study measurements (Kelly et al., 2013).

Recommendations for Action

I have three main recommendations for action as a result of this study. First, the results from this study revealed unprotected sex, age group between "18-24" years, number of sexual partners, and relationship status were significant risks to being HIV positive. These results should be shared widely among the targeted stakeholders (communities, clients, service providers, VMMC implementing, and development partners). Dissemination of the findings should be done through various appropriate channels (i.e., publication in peer-reviewed journals, expositions in local and national professional forums, and local public forums (commonly known as barazas) one of the necessary actions in this respect.

Secondly, NASCOP and NACC should develop an age-appropriate tailored HIV risk reduction and VMMC pre- and post counseling guide. This guide should not replace other existing counseling materials developed by other agencies of the Ministry of Health. This guide may act as the reference for standardization of HIV risk reduction and VMMC pre-and-post counseling. The guide should include comprehensive minimum standard information essential for attaining maximum outcomes from VMMC interventions as well as a training manual for VMMC counselors as part of the comprehensive package of HIV prevention services.

Finally, the NACC Strategic Plan for 2015-2019 emphasizes the need to reduce the number of sexual partners as one of its intensification efforts in HIV prevention. The result of this study showed the need for more comprehensive HIV prevention interventions targeting behavioral risk factors. The study provided more justification for developing and implementing partner reduction strategies among the sampled population and fidelity amongst the married couples in Homa Bay County, Kenya. The study reported an average number of non-marital sexual partners of 1.48 [±1.55] (two out of every three males in Homa Bay County, Kenya, had two or more sexual partners). This average was higher than the national average of two out of every five Kenyans (KNBS & ICF Macro, 2014). Therefore, based on this study's findings, NACC and Homa Bay County, Kenya should develop straightforward information, education, and communications messages aimed at reducing multiple concurrent sexual relations in the fight against HIV infection in Homa Bay and Kenya. These messages should take into consideration the interrelated gender roles, class, socio-cultural, and economic dynamics. Understanding such dynamics is essential in developing partner reduction strategies and messages that discourage or disallow multiple partnerships.

Recommendations for Future Studies

Taking sexual histories outside the clinical settings, as applied in this research, and collecting adequate information on some of the contextual factors, is reinforced by the literature (Oshri et al., 2013; Wray et al., 2016). However, future studies should concentrate on assessing behavioral and structural changes in the new HIV infections (Grangeiro et al., 2015) among hyperendemic populations (Tanser et al., 2014).

Behavioral changes are often modified or moderated by beliefs, prevention needs, contextual circumstances, and lifestyles (Grangeiro et al., 2015). It would be interesting to find out if the behavioral changes observed after the biomedical intervention (VMMC) were as a result of spontaneous changes. Or whether more comprehensive public health measures, supported by focused social mobilization messages, in addition to structural changes and government policies, were responsible for generating social transformation (Grangeiro et al., 2015; Wet et al., 2019).

Implications

Positive Social Change

Globally, Kenya shares the third-highest HIV epidemic with 1.6 million living with HIV, 46,000 new HIV cases, and about 25,000 annual AIDS-related deaths (Joint United Nations Programme on HIV/AIDS (UNAIDS), 2019). At the same time, creating severe economic burden leading to reduced labor supply, increased health sector, and household costs. The average economic unit cost per patient was $275 (adults) and $319 (pediatrics) (U.S. Centers for Diseases Control and Prevention and Kenya Ministry of Health, 2013).

The study has presented data on the magnitude, seriousness, geographic distribution, and prevalence of unprotected sex, concurrent, multiple sexual relationships, and related HIV risk factors in Homa Bay County, Kenya. This data could help design and communicate careful and accurate information about the actual protection from VMMC, the risk of unprotected sex, the age groups to be given preferential targeting in HIV prevention, and the effects of multiple sexual partnerships in Homa Bay County, Kenya. These targeted communications and campaigns could result in behavior change in the adoption of safe sex practices. This could lead to positive social change by inspiring males and females to be more aware and conscious about their sexual health and take joint social responsibility in preventing new HIV infections. This change of behavior could reduce new HIV infections and may impact the quality of lives among men and their families.

This study also has the possibility to impact the social change at the community, society level, and healthcare stakeholders. The findings may generate debates that could intensify the knowledge of HIV risk factors among circumcised males in Homa Bay County, Kenya. This could lead to increased understanding and may provide ideas to public health professionals and policymakers to identify and tailor HIV interventions. These interventions may advance positive social change by decreasing social and economic costs related to HIV treatment and care. This may also include the implementation of HIV prevention and control practices. The Homa Bay County (ministry of health), health experts, community health teachers, and stakeholders could also use this new knowledge as baseline epidemiological data to understand how HIV spreads among the circumcised males in the county. Homa Bay County may also use this data to develop appropriate strategies to address the specific HIV risk factors identified by the study to reduce the new HIV infections and other sexually transmitted diseases. Reduction of new HIV infections may lead to possible social change and a significant increase in the quality of lives and well-being of the individuals, families, and possible ripple effect to benefit the Homa Bay County health sector to focus on other areas of importance.

Conclusion

This study was designed to investigate whether there are any differences between belief about VMMC, unprotected sex, age, number of sexual partners, relationship status, and HIV status among HIV negative (controls) and HIV positive (cases) circumcised males aged between 18-49 years in Homa Bay County, Kenya. Previous RCTs conducted in Sub-Saharan Africa were focused on the behavioral response to VMMC and found inadequate or no evidence for an association between beliefs about VMMC and HIV status (Lawal & Olapade-Olaopa, 2017; Wamai et al., 2012). However, these studies have reported several limitations and the gaps in knowledge of any association between beliefs related to the protection of VMMC, sexual activities, and HIV infection. I attempted to address the gaps identified by conducting a case-control study design involving a combined 936 (468 cases and 468 controls) males. The study investigated the association between belief about VMMC and HIV status as an outcome controlling for unprotected sex, age, number of sexual partners, and relationship status. Depicting from the HBM theoretical and conceptual framework, that postulates that the majority of males receive VMMC due to their perceived vulnerability to HIV infection and alongside the additional belief that VMMC will decrease their risk of getting HIV (L'Engle et al., 2014). This study applied bivariate logistic regression, and the results were shown as odds ratios (*OR*), and 95% Confidence Intervals (CI) and corresponding *p*-values to ascertain significant independent variables linked with HIV status.

The findings from this study revealed that unprotected sex, age groups between "25 - 31" years, number of sexual partners, and relationship status were significantly associated with HIV status. While belief about VMMC, and when stratified, were not significantly associated with HIV status. I observed high proportions of circumcised males to be having multiple or concurrent sexual relationships. Therefore, the advancement of VMMC for HIV prevention strategy should be treated with extreme caution in Homa Bay County, Kenya. However, issues concerning behavioral disinhibition should not hinder the extensive scaling-up of VMMC initiatives, especially in lessening the spread and burden of HIV transmission (Westercamp et al., 2014). HIV prevention messages should target males aged between 39 and 49 years who engage in unprotected sex with a greater number of partners and multiple relationship statuses.

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Appendix A: Behavioral Surveillance Survey Instrument

1. Questionnaire number:___ ___ ___ ___
2. Sub-counties

    Kabondo Kasipul…………………1
    Kasipul……………………………2
    Karachuonyo……………………....3
    Homa Bay Town…………………...4
    Ndhiwa…………………………….5
    Rangwe…………………………..…6
    Mbita……………………………….7
    Suba………………………………....8

3. Name of health facility?______________________________
4. Name of location ______________________________
5. Date of Interview?<dd/mm/yy> ___ ___ /___ ___ /___ ___

Part 1: Background Information

No	Questions	Coding	Skip
101	Are you willing to share with me your HIV test results you did/received today?	No ……………………………..0 Yes …………………………….1	**If 0 skip to End**
102	If yes, What was the test result?	Negative……………………..…0 Positive…………………………1 No response…………………..99	**If 99 Skip to End**
103	What is your date of birth?	Year [__|__] Age (years) [__|__] Don't know year …………….88 No response …………………99	**If Not between 18-49 Skip to End**
104	Are you circumcised?	No ……………………………..0 Yes …………………………….1	**If 0 skip to End**
105	What type of circumcision did you receive? [Will have to explain what each type of circumcision mean]	VMMC…………………………1 Traditional……………………...2 Infant…………………………...3	**If NOT 1 skip to End**
106	Which year did you receive the VMMC procedure? Indicate the facility/location where it was done.	Year [__|__] **Where? ________________**	
107	Did you know your HIV status before circumcision?	Yes …………………………….1 No ……………………………..2 Don't know …… ……………..88 No response …………………..99	**If NOT 1 Skip to end**
108	If yes, what was the test results before VMMC	Negative……………………..…0 Positive…………………………1 No response…………………...99	**If 0 Continue ELSE Skip to end**

Part 2: Sexual Annals: number and types of relationships

No	Questions	Coding	Skip
201	Marital status?	Single……………………………1 Married…………………………..2 Separated…………………………3 Divorced………………………….4	
202	**If Married**: To how many wives/men?	1 partner………………………..1 2 partners……………………….2 >2 partners………………………3 No response …………………..99	
203	Have you had sex in the previous 12 months?	No ……………………………..0 Yes ……………………………1 No response …………………..99	**If 0, Exclude from study [END]**

Now I am going to ask you about your female/male sexual relationships in the previous 12 months.

No	Questions	Coding	Skip
204	Number of regular/stable sexual partners?	Number [__|__] Don't know ………………….88 No response …………………99	
205	Number of commercial/ transactional sexual partners?	**Number** [__|__] Don't know ………………….88 No response …………………99	
206	Number of non-regular/non-spouse/non-cohabitating/non-commercial? sexual partners?	**Number [**__|__] Don't know ………………….88 No response …………………99	
207	Can you now summarize the total number of different non-marital sexual partners you have had penile-virginal intercourse (PVI) or penile-anal within the last 12 months?	Total……………_____________	

Source: Adapted from BSS, Family Health International (FHI), 2000.

Timeline Follow Back (TLFB) Approach

Part 3: Sexual histories

Think about all your regular/stable sexual partner(s), non-regular partner(s), and commercial/transactional partner(s). I would like you to plot all the sexual experiences with each of them over the last 12 months. For each sexual partner, I will ask you the relationship status with that partner and whether you used a condom at last sex.

Sex partner #	Relationship status	Did you use a condom at last sex?
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Relationship status (1=marital/spouse; 2=stable/ serious girlfriend/living together; 3=casual/no commitment/one-time sexual encounter; and 4=female sex worker/ transactional sexual partner)
Did you use a condom at last sex? (0=no, 1=yes,)

Part 4: Belief about VMMC

No	Question	Coding	Skip
401	Generally, what level of protection do you think the VMMC offers against HIV infection?	No protection…………………...1 Partial protection……………….2 Complete protection……………3 Don’t know…………………....99	

End.